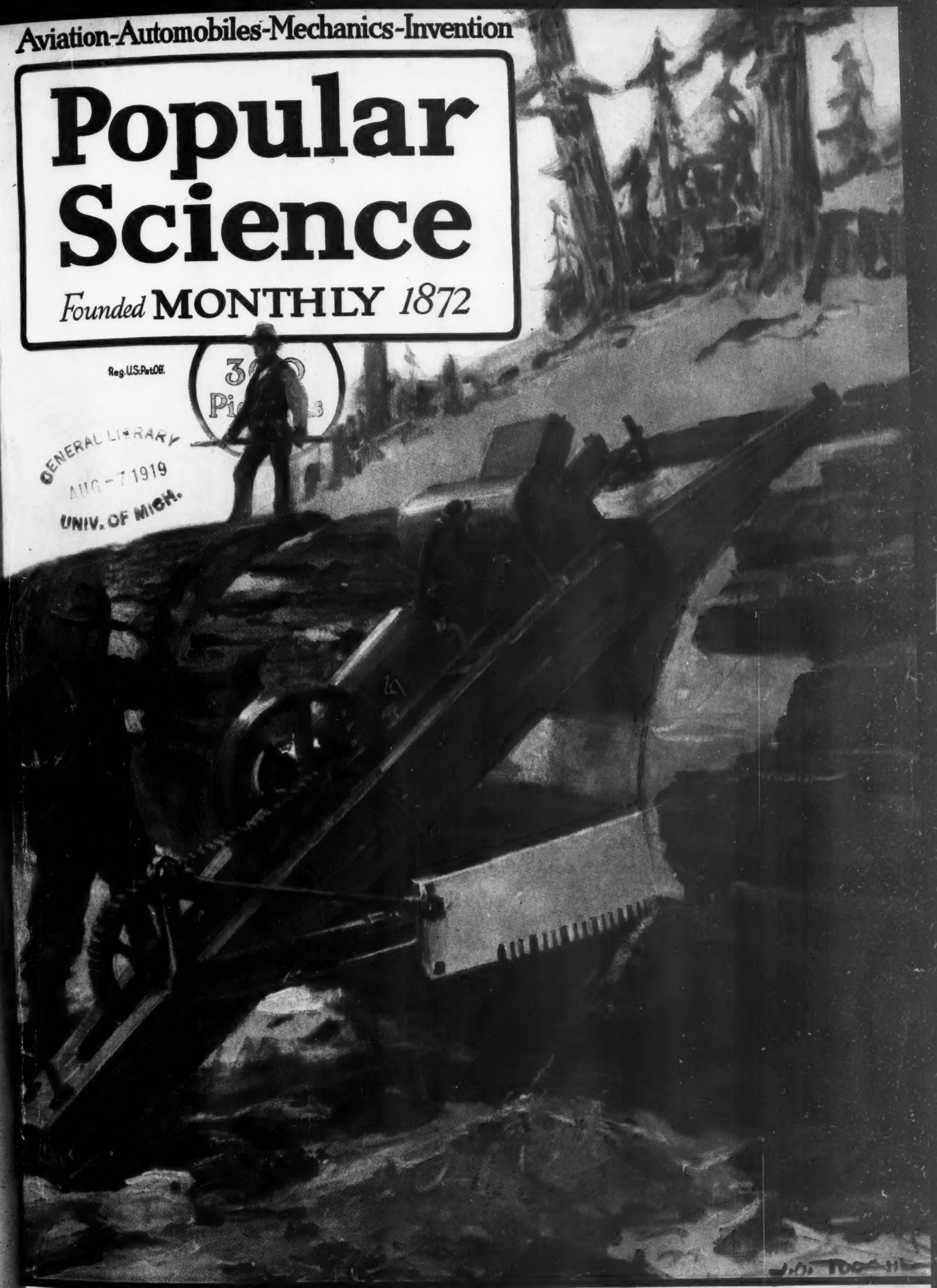
Aviation-Automobiles-Mechanics-Invention

Popular Science

Founded MONTHLY *1872*

Reg. U.S. Pat. Off.

GENERAL LIBRARY
AUG - 7 1919
UNIV. OF MICH.



AUGUST — *Sawing Logs with a Gasoline Engine* — 20 CENTS

It's toasted

YES, it really <u>is</u> toasted. That's plain sense. Bread tastes better toasted. So do muffins, crackers, cheese. And so does tobacco, of course —especially <u>real</u> Burley.

LUCKY STRIKE cigarette

It's toasted

You can't get the delicious toasted flavor in any other cigarette.

But for your pipe? Yes, indeed—Lucky Strike tobacco, same famous formula.

© Guaranteed by
The American Tobacco Co.
INCORPORATED

Popular Science Monthly

Waldemar Kaempffert, *Editor*

August, 1919; Vol. 95, No. 2
Twenty Cents; Two Dollars a Year

Published in New York City at
225 West Thirty-ninth Street

Mapping the Earth from the Sky

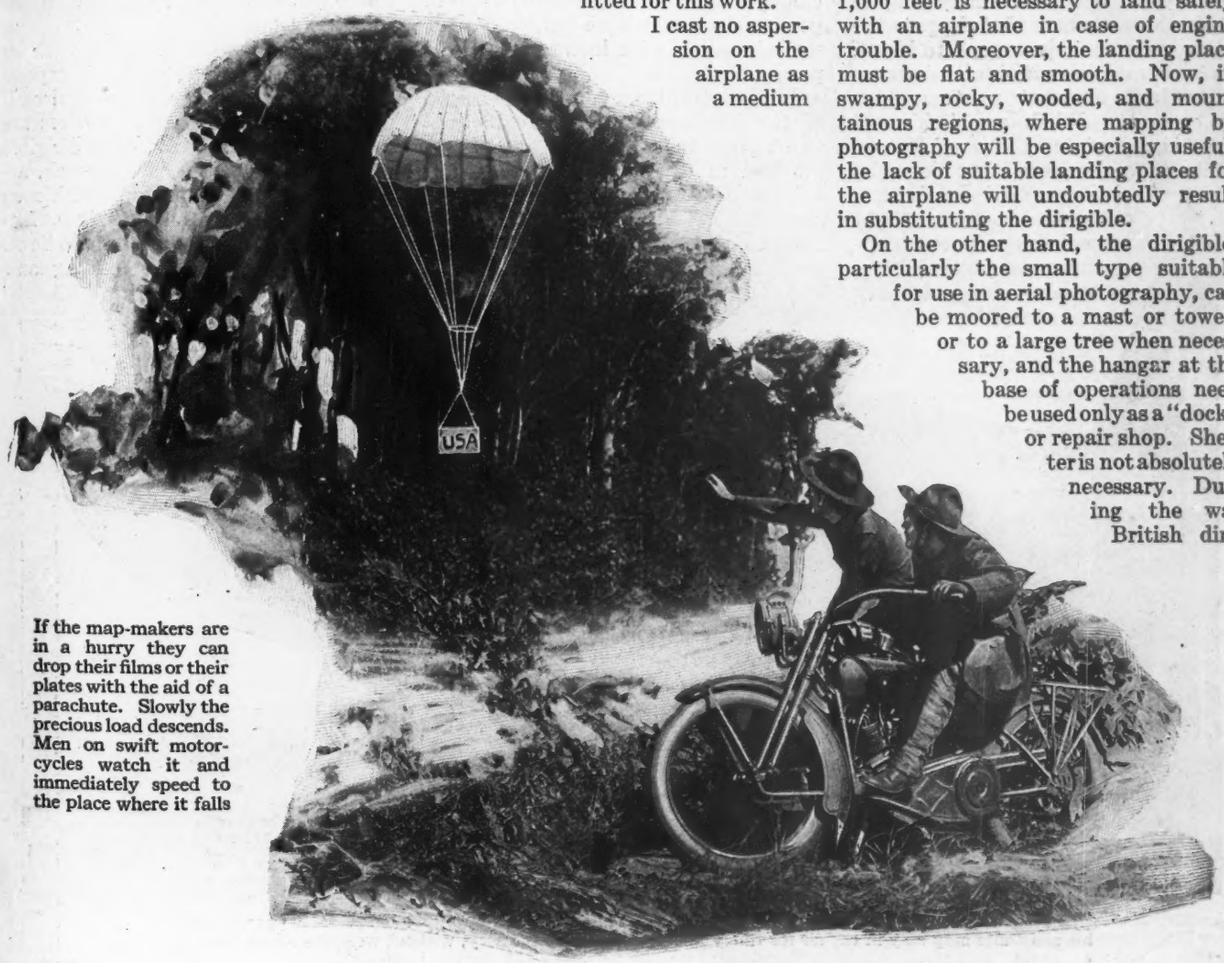
Why the dirigible is the ideal vehicle for the taking of aerial photographs

By James Prentice, *Colonel in the Aviation Section Aeronautics*

As a vehicle for photographic mapping the dirigible is ideal; for it can be stopped in midair and it can easily be raised or lowered to any altitude desired, both very important considerations for the careful aerial photographer. The war gave to air photography an impetus it could not have received in any other way. New surveying methods, particularly the methods of mapping hitherto impenetrable and therefore uncharted regions and of making comprehensive progress and valuation reports, are now available. The "blimp," as it is popularly termed, is specially well fitted for this work.

I cast no aspersion on the airplane as a medium for aerial photographic work. In certain kinds of reconnaissance, particularly where speed is essential, as in war photography, it is in a class by itself. But in times of peace different factors must be considered. For instance, for every mile of distance away from a landing haven an altitude of 1,000 feet is necessary to land safely with an airplane in case of engine trouble. Moreover, the landing place must be flat and smooth. Now, in swampy, rocky, wooded, and mountainous regions, where mapping by photography will be especially useful, the lack of suitable landing places for the airplane will undoubtedly result in substituting the dirigible.

On the other hand, the dirigible, particularly the small type suitable for use in aerial photography, can be moored to a mast or tower, or to a large tree when necessary, and the hangar at the base of operations need be used only as a "dock" or repair shop. Shelter is not absolutely necessary. During the war British diri-



If the map-makers are in a hurry they can drop their films or their plates with the aid of a parachute. Slowly the precious load descends. Men on swift motorcycles watch it and immediately speed to the place where it falls

gibles were moored in the open for months without damage. Landing is simple. On calm days a ten-acre area is big enough. Moreover, the space need not be clear of shrubbery and stumps. Bases may be maintained near rivers, etc., so that problems of transportation are simplified.

The Dirigible's Flight Duration

In duration of flights the dirigible is especially advantageous. Four or five hours of work in an airplane is about all the strain that a photographic operator can endure at a time. In a dirigible there is no such strain. A photographic operator and his assistants may stay in the air for thirty hours or more, if necessary, without worrying about landing.

Consider, too, the ease with which a small dark-room may be added to the dirigible's equipment. For water the photographer can tap his water ballast. This convenience is worth more than may appear at first sight. It enables the photographer to experiment at different altitudes and with different cameras and different plates to get the best results with the prevailing light over the territory. Added to this convenience is that of freedom of movement and the absence of the restraining belt necessary in airplanes.

As every man knows who goes up in the air, there is a haze that clings to the earth's surface; objects tend to blend. It is harder to pick out objects, because of the lack of what photographers call contrast. When an airship attains heights of ten thousand feet on certain days the haze is so dense as to cut off almost entirely one's view of the earth. By means of specially prepared panchromatic plates (which, unlike the ordinary plates, are sensitive to all colors of light) and color filters, which exclude the predominating blue light of the haze or cut it down and permit the penetration of light of other colors, excellent pictures of true color and shade value are obtainable. The photographer may want to experiment with his filters or his plates to get the correct penetration of the haze below him. All this becomes possible in the small dark-room of the dirigible.

Where the dirigible is used to obtain special bird's-eye views of large building projects for progress reports, there is one position or altitude where the best picture can be obtained. Because of the flexibility of the dirigible its operator can maneuver it about until the photographer is absolutely satisfied that the most favorable position has been found.

Absence of Vibration

Because of the lack of vibration and necessity of going up to high altitudes to provide a safety factor for forced landing, the need of elaborate camera equipment is not so great. At the low altitudes to which a dirigible can fly, ordinary plate cameras, or even hand kodaks, can be used. Furthermore, the absence of vibration permits one to make longer exposures on dark cloudy days to get the same type of good picture which on lighter days is made possible with instantaneous exposures.

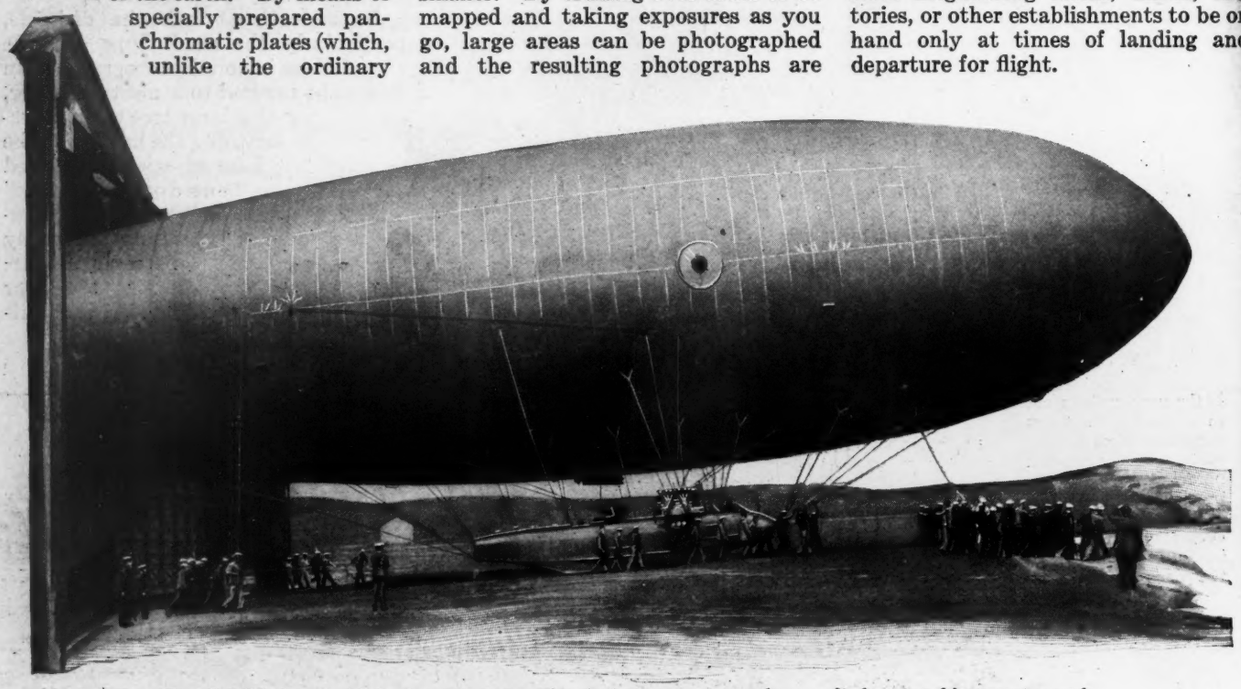
In photographic mapping, at a height of ten thousand feet, approximately two square miles of area are photographed at each exposure; at lower heights the area is proportionately smaller. By cruising over areas to be mapped and taking exposures as you go, large areas can be photographed and the resulting photographs are later pieced together in an accurate mosaic. By tracing this mosaic trained draftsmen make a map that is absolutely correct.

Cost an Important Consideration

Of course, the cost of dirigibles for use in commercial aerial photography is an important consideration. Even a small dirigible probably costs more than $25,000. If a shed is required an additional $10,000 will be necessary, although, as already stated, the British dirigibles were moored in the open for months during the war. The British authorities found that it costs about $1,200 a month to operate a ship. With the development of better fabrics and more efficient methods of inflation and repair, the life of the ship can be lengthened to three years.

Apparatus for the detection of leaks in the bags has become so efficient, and the "dope" that is sprayed on by air-guns so effective, that there is not now much loss of gas. It is no longer difficult to obtain hydrogen, since the process of hardening fats has become a rapidly growing industry and well established in various parts of the country. At comparatively low prices it is possible to provide hydrogen, which can be stored in iron bottles until used. Helium is a safer gas than hydrogen, and is used where absolute safety is required.

To land a small dirigible such as would be used in photographic expeditions, only twenty men are required if proper landing ropes and devices are provided. Moreover, since a dirigible can give warning of its approach, arrangements could be made with men from neighboring farms, mines, factories, or other establishments to be on hand only at times of landing and departure for flight.



The dirigible has decided advantages over the airplane as a camera base. A photographic operator and his assistants may stay in the air for thirty hours or more, if necessary, without worrying about landing

They are piecing together hundreds of photographs from the air in order to make a mosaic so wonderfully rich in detail that it would take a skilled chart-maker a century to produce its equivalent by hand. The dirigible lends itself even better than the airplane to the making of such maps; for, unlike the airplane, it can float above a given spot for hours. It is easy to imagine what that means in getting good photographs of the ground below

Special motor-trucks have been designed, with traveling dark-rooms, for developing and printing negatives in the field. But it is possible to install a dark-room on the dirigible itself. The photographer can tap the water ballast in order to wash his negatives and prints

Electrocuting David to Save David's Coat

MURDER in self-defense won't condemn a man to death; his crime must be sufficiently cold-blooded and premeditated to be placed in the murder-in-the-first-degree class before the death penalty can be served. But the law is not so particular as to animals. They may be electrocuted for plain premeditation without the murder.

Look at David, the leopard. He was a circus animal, and on several occasions he acted as if he would have liked to take a bite out of someone. Now he is standing on a steel plate which is connected by a wire to a 6,000-volt power-house, and by another wire to David's leg. When the man at the switch closes it, the electrocution will take place.

Death by electrocution was selected in order to save David's coat. Leopard skins make beautiful coats and rugs. Before long David's skin will most likely appear on some rich man's wife or floor.

© Western Newspaper Union

A New and Better Use for Poison Gas

THE poison gas that gassed the Germans is now gassing English rats. It was Captain Eden Richardson, formerly a gas instructor in France, who first sent poison gas down rat-holes. He attached one end of a rubber tube to a gas-cylinder, and stuffed the other end down a rat-hole. Then he put on his gas-mask and turned on the gas. The rats that were not immediately annihilated crawled out in such a dazed condition that they were quickly and easily killed.

Why go to all this trouble when solid or liquid poison will work just as well? Because all the rats in the run will succumb to gas, whereas by the other method only those that the poison touches will die. Then, too, when the gas has passed off the bodies are not left in a poisonous condition. In fact, experiments have demonstrated that it is perfectly safe to eat gassed rabbits after the gas has passed off.

Hiawatha Makes His Home in a Tree

A TREE doctor with artistic tendencies was called in to fill up a decayed cavity in a tree—a most inartistic job. But the tree grew in Longfellow Gardens, Minnehaha Falls, Minnesota, a park dedicated to the great poet Longfellow.

There sentiment was rife, and the artistic tree doctor grew bold. When he had filled up the cavity he finished the job by modeling a statue of Hiawatha on its surface.

Was it appreciated? We are told that "no figure could have been of more poetic fitness."

Minnehaha Park is located in Minneapolis, and is the place of which Longfellow tells in his poem "Hiawatha." The famous Falls, which have a drop of about fifty feet, are located in Minnehaha Creek.

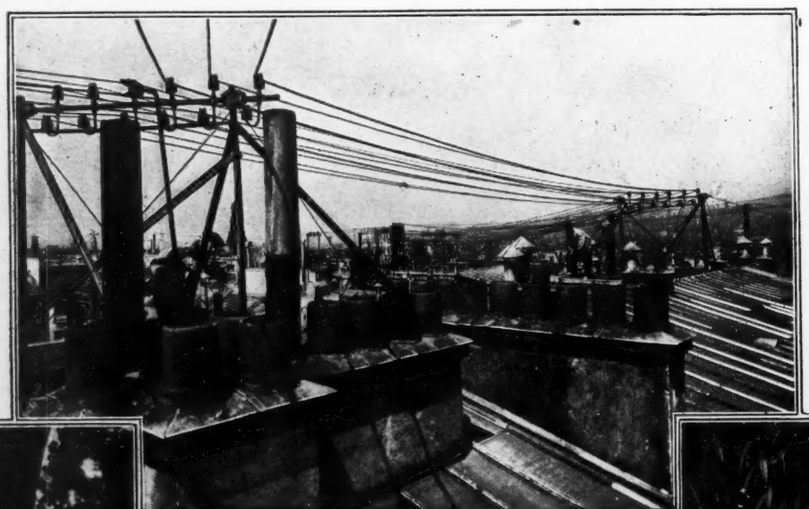
Tree-Stumps Manufactured to Order

TREES are not planted with a view to how their stumps will look when they are cut down many years later. And so, now that tree-stump garden-seats are stylish in California, many owners are worried: their stumps are all in the wrong places. Must they plant seeds and wait fifty years for the trees to grow?

By no means. Concrete stumps are now being manufactured.

They weigh only sixty pounds; so, if the owner tires of seeing them in one place, he can easily shift them to another. Of course there is this disadvantage: if anybody leaned heavily to one side while sitting in one it might topple over.

The stumps are made hollow, and they are molded over wire reinforcements.



So This Is Paris!

"WHAT shall I do with these wires?" is a question that the Parisian electric lineman continually asks himself.

He is assigned to the job of wiring a house; and yet, according to the law-makers—who nevertheless use electric light and power—he must hide the evidence, leaving no wires where they will disfigure the streets.

What does the lineman do? He travels over the housetops, which fortunately are nearly always level, and fastens his wires amid the famous chimney-pots.

When the wind is high, it's a difficult job to perform on slanting roofs.

It Rang the Armada's Knell

WHEN peace was declared, formally ending the most terrible of wars, the bells of Westminster Abbey told the news. One of these bells—the one in the foreground of the picture above—has been ringing out glad tidings for more than three hundred years. It chimed the story of the dispersal of the Spanish Armada when British seamen and North Sea gales saved England from invasion in the summer of 1588.

The Westminster bells are six in number, the treble of the sextette being an early fourteenth-century bell. Two smaller bells are to be added to complete the octave, and when this is done the venerable Abbey will have the heaviest "ring" of eight in London.

All of the bells, with the exception of the fourteenth-century one, were cast at the Whitechapel Bell Foundry, where the famous Bow Bells were also cast.

Rushing the Vegetable Season

SHOULD you ask this digger of lettuce, "How does your garden grow?" she would tell you with pride, "Ahead of season." She is one of a group of English farmerettes who are raising three crops of vegetables each season.

They start planting very early, and place large glass jars—"clochers"—over the young vegetables to protect them from wind and frost. Five plants are usually started under one of these clochers. When they have a sufficient grasp on life, they are transferred to glass-covered frames. The head of lettuce that is being dug up in the picture above is going to be put in one of the frames.

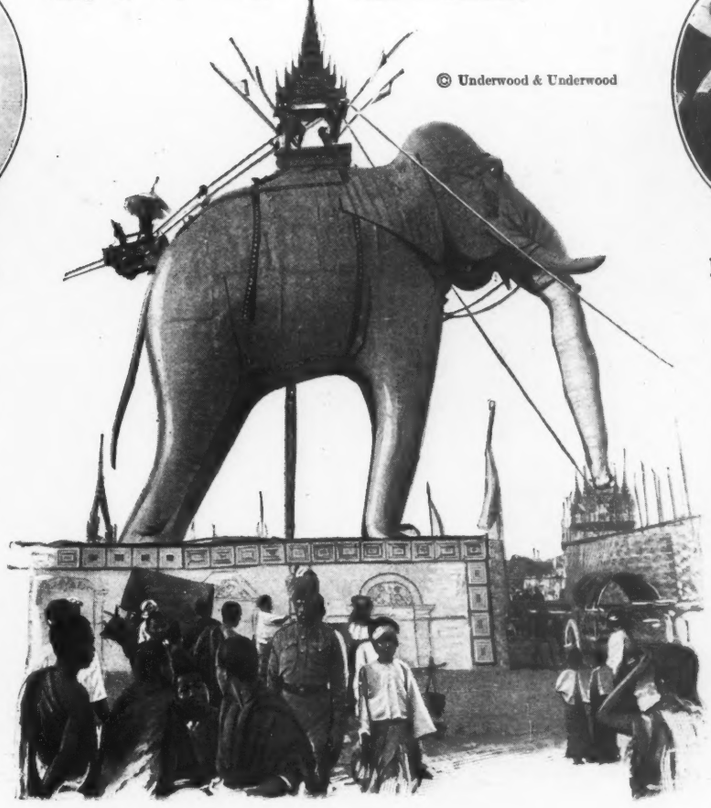
As the plants selected for early planting are hardy, there is little danger that frost will affect them while they grow under the clochers. But when the growing plants are transferred from the clochers to the frames very great care must be taken.

On the Road to Mandalay

WHEN you look at the monstrous, seventy-five-foot elephant with a pagoda on its back, don't dub the scene Coney Island, Luna Park, or even an ordinary circus. This elephant is a funeral coach, and it is brought out only when the great folk of Mandalay die. This time it was a Buddhist archbishop, and his gaudy coffin can be seen crawling up the elephant's back by way of a block-and-tackle.

The rest of the funeral procession is made up of equally elaborate floats, and when they all start off for the cemetery they look for all the world like a Mardigras parade.

Kipling never told us we were likely to meet anything like this on the road to Mandalay.



© Underwood & Underwood

Lima Adopts Tin Hats for Its Coppers

WHEN the New York police shifted some years ago from the old-style helmet to the more modish caps, there was some wailing on the ground that the cap was poor protection against a blow on the head—dropping a brick on the "cop" having long been the favorite sport in the "tough" sections of every town.

Lima, Ohio, is the first city to take a leaf out of the soldier's book and provide tin hats for members of the force who have troublesome beats. This does not mean that brick-throwers flourish any more in Lima than in New York's Cherry Hill.

Hang Your Glasses on Your Hat

IF you refuse to wear spectacles, and pinch-nose glasses pinch too much, then why not hang your glasses on your hat? That is the suggestion of J. A. Taylor, of Waco, Kansas, who has invented a spectacle support which he calls the "chandelier." To use it you must wear a peaked hat, never change the angle at which you wear it, and never tip it.

The lenses hang on the ends of rods which screw through the peak of the hat. When the glasses are not in use, you turn the peak back and fasten the glasses in place by means of a clip that clutches the cross-bar.

The Ready-Made House

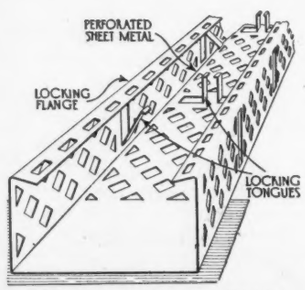
Floors, roofs, and steps are now built in a factory

"CLEARANCE sale. Ready-to-wear floors, roofs, and steps greatly reduced."

A queer advertisement, to be sure, but one that may before long appear in our newspapers and magazines. Why? Because Mr. C. F. Cramer, of Indiana, Pa., has patented ready-to-wear concrete "structural units."

These units are concrete-filled metal troughs which are fitted into place in houses as floors, roofs, steps, lintels, or footings. They are locked together by workmen who know practically nothing about concrete or building construction; for no tamping, testing, or riveting is necessary, and the usual forms, chuting-towers, and runways are dispensed with. All necessary operations are performed in the factory. The delivered blocks or logs are simply hoisted up and laid in place on the framework of the building.

In manufacturing the metal troughs, they are provided with reinforcing bars and bolts for strengthening the concrete. They are also perforated along the bottom to allow some of the concrete to ooze through, so that the plaster of the ceiling below will cling to it. One side of each trough has an extending arm, which clutches the concrete of the trough next to it, locking the two together. The concrete of the second trough is grooved to receive the arm of the first one, and in all cases the concrete is piled higher than the sides of the trough.

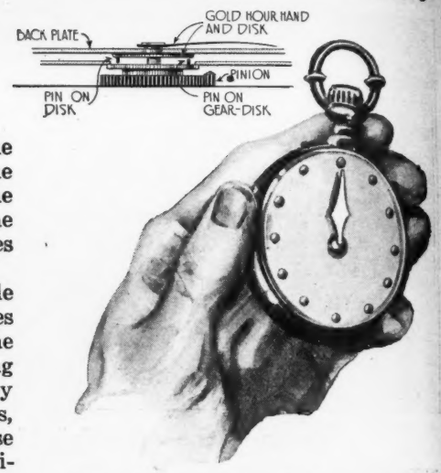


Each metal unit is provided with a bar that locks it to its neighbor, fitted with grooves

In placing one of these ready-made floors in a house, the builder first takes measurements and then places the metal troughs accordingly, leaving spaces and holes for the necessary wiring and piping, lighting fixtures, line shafting, and fasteners. These troughs are filled under ideal conditions in the factory, and are then conveyed to the house in process of construction. The final work of putting them in is done quickly and easily. No waiting for the concrete to harden and season, no delays because of weather conditions, and a great saving in material, time, and the cost of labor.

It takes but ten minutes from the time a trough is lifted out of the delivery wagon until it is fastened to a floor, ready to be worked on and walked over. In case the owner does not like concrete floors, wood floors can be easily nailed to the slabs.

When the troughs are used as steps, they are joined somewhat differently and the interlocking grooves are filled with cement.

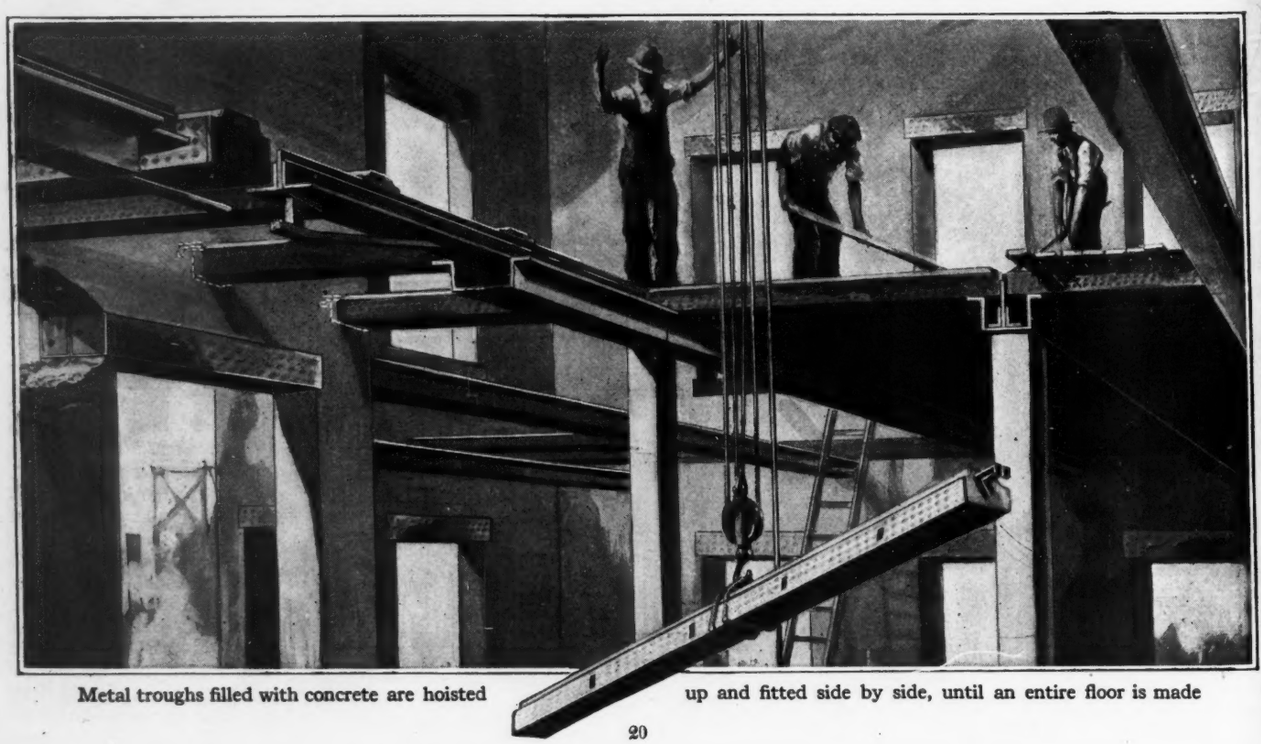


The gold hand moves freely counter-clockwise, but stops on the correct time when it is turned with the clock

Seeing the Time with the Finger-Tips

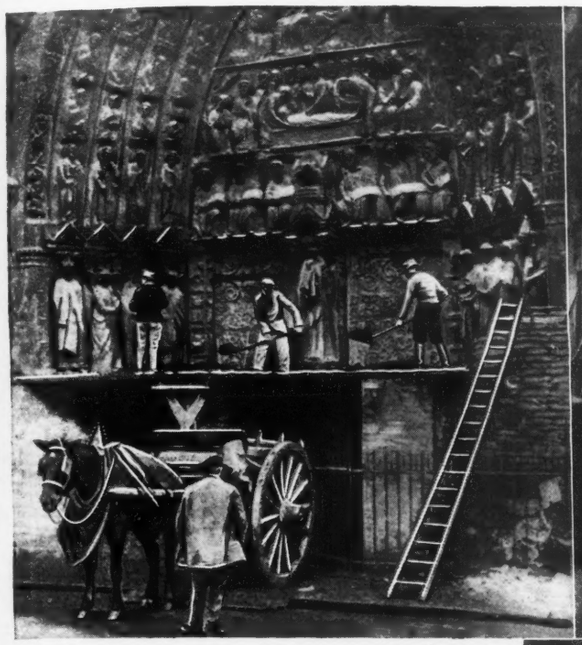
A WATCH by which the blind may tell time, the invention of Bréguet in Paris, has the usual dial with two hands in the front. On the back, along the rim, are twelve small gold pins or knobs, placed to correspond with the hour divisions on the front dial.

The mechanism includes a pinion of six teeth driven by the watch-spring and revolving once every hour. It is geared to a wheel with seventy-two teeth, which makes one complete revolution in twelve hours. The large wheel has a pin the position of which always corresponds with that of the hour-hand. It stops a pin on the watch-hand when the latter is turned with the clock.



Metal troughs filled with concrete are hoisted up and fitted side by side, until an entire floor is made

Removing the Barricades of Paris



The Israelitish kings that grace the doorways of Notre Dame were sand-bagged when bombs began to fall on Paris. The sand-bags are being removed now, and the kings reveal no signs that they have been through the war; so they are free to breathe again, if they care to do so. It was in Notre Dame that the people of Paris were gathered in an agony of prayer on that early day of the war when the Germans nearly reached Paris and were turned back

Photographs © International Film Service

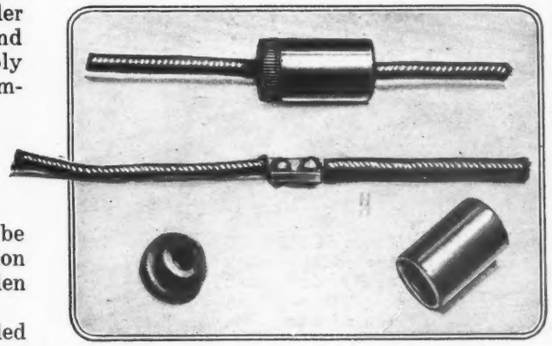
Like winter homes in summer, the large glass windows of the Paris newspaper *Le Matin* were all boarded up during the war. The protection is coming down, now that the glass is safe from shell shock and falling bombs

Surely this statue had to be protected from the German bombs; for it is the Vendôme Statue, and it was made from German cannon captured in the Franco-Prussian War. It needs no protection today, and it won't have any long

Permanent Wire Connections Made without Solder

SCORCHED woodwork, singed insulation tape, drops of solder on the floor, bad smells, dirt, and irritation are almost invariably the annoying features that accompany the making of permanent electric wire connections in houses, offices, or factories. The wires must be twisted together and soldered, then the place of juncture must be wrapped with sticky insulation tape, before they can be hidden behind a molding.

All this trouble can be avoided and time saved by using an insulated wire connector recently placed on the market by a Canadian manufacturing concern. The device is surprisingly simple. It consists of a flat connecting piece of copper or some other good conductor and a capsule or shell of insulating material with a screw-cap.



Fasten the wires to a connecting piece, cover it with a shell of insulating material, and a permanent connection is made

When a connection is to be made, the shell is slipped over one of the wires, the screw-cap over the other. Then the ends of the two wires are securely fastened by means of clamp-screws to the connecting bar, which fits snugly into the insulating shell. No soldering is necessary. Finally the shell is slipped over the juncture and the cap is screwed down tightly.

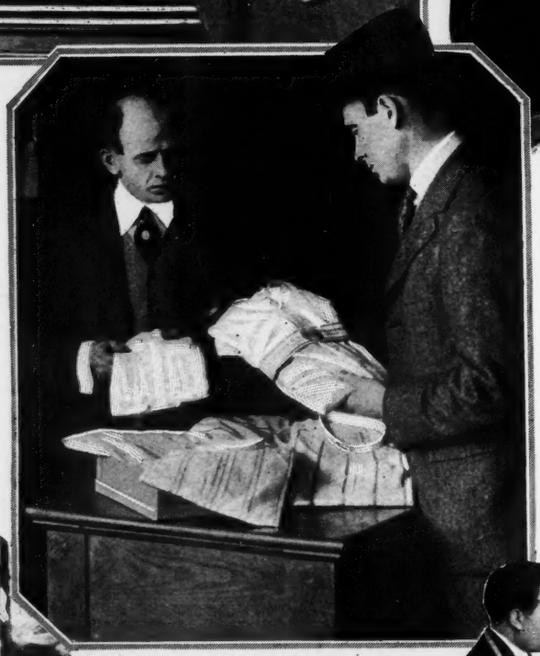
Budgeting Your Wardrobe

What it costs to wear clothes for a day

A 25-cent collar lasts fifteen days—cost per day, less than two cents; and a $2 tie lives twenty-five days—eight cents a day for the budget

Hats at $6 may sound expensive, but the budgeteer says they wear one hundred and twenty days, which means only five cents a day. Expensive things are often found to be the cheapest

If a $50 suit wears six months, that's twenty-eight cents a day; if a $40 suit wears four months, that's thirty-four cents a day. What's the answer? A budget system will save you money on clothes—and War Savings Stamps are a fine investment



That suit at $55 has one hundred and twenty days of prospective life, at forty-six cents a day; and the $50 overcoat, lasting two hundred and forty days, costs you twenty-one cents a day

A shirt at $3, with a thirty-day life, means ten cents a day, and $5 underwear, lasting forty-five days, costs eleven cents daily

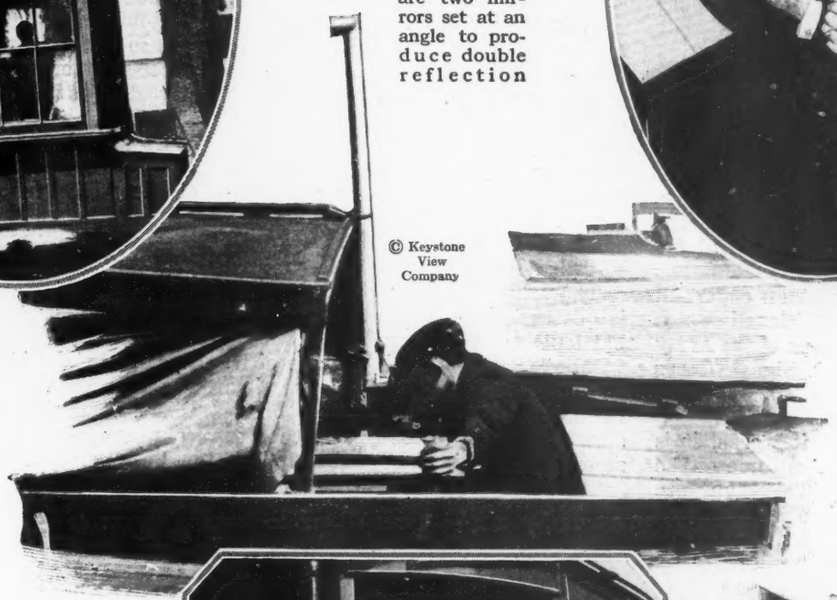
Shoes at $12 keep the cobbler away ninety days—cost per day, thirteen cents; and since $1 socks last thirty days, that means three cents each day for the clothes budget

Peace-Time Peeps through Periscopes

Useful in many places besides the submarine

Perhaps there will be dirty work at the cross-roads tonight, but it won't be at these cross-roads. For the careful gate-keeper has a periscope attached to his house, through which he can see the trains approach around the curve below

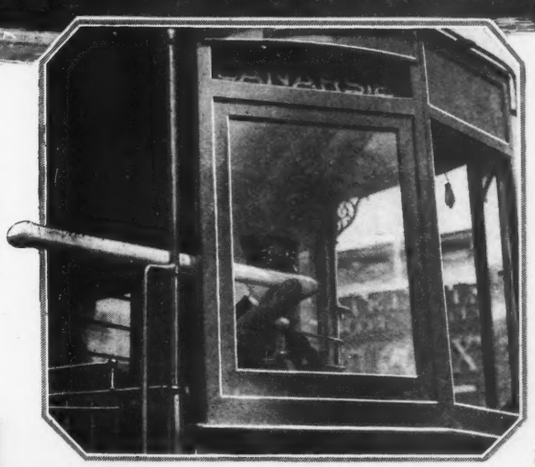
Dashing through the waves in a high-powered hydroplane, he watches the path ahead by looking through a periscope; inside a periscope there are two mirrors set at an angle to produce double reflection



© Keystone View Company

© Underwood & Underwood

In this case the trench is an orchestra-pit, and No Man's Land the stage. By watching the actors through a regular trench periscope, the musical conductor, Herbert E. Hyde, was able to lead his orchestra



This motorman can see people boarding his car in the rear, though he looks straight ahead. Eyes in the back of his head? No; he uses a periscope

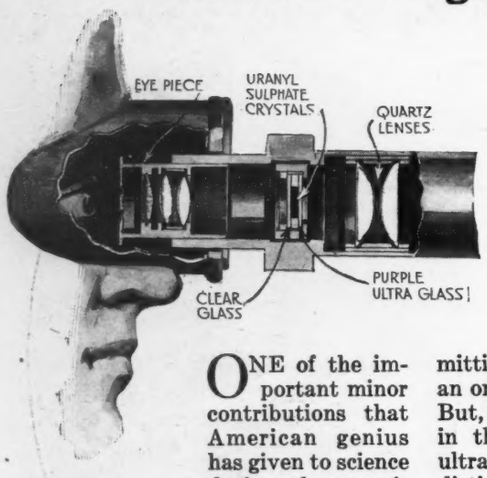
© Keystone View Company

© Keystone View Company

"Here comes the bride!" said the woman who had brought her periscope. She saw Princess Pat's wedding procession. The other women could see none of it, and so they stared at the photographer

They alternately glue their eyes to the lower end of a periscope, the top of which overlooks the edge of a fence on the other side of which a thrilling ball game is in progress

"Invisible" Light Signals



A tuning-fork, when it vibrates, gives off but one note. Like sound, light is the result of a vibration. Suppose that you could pick out of a light the particular vibration you wanted to see. You would then have something corresponding with the single note of a tuning-fork. The instrument shown here enables you to pick out of a light only those vibrations that you wish to see. Thus it becomes possible to signal secretly. Others may look at the light with an ordinary telescope; they will see nothing unusual

ONE of the important minor contributions that American genius has given to science during the war is the use of ultra-violet rays for secret signaling. The work was begun by Irwin G. Priest and Dr. K. S. Gibson, of the Bureau of Standards, who made several reports on this subject to the Navy Department. It was later taken up by Professor Wood of Johns Hopkins, long known as an expert in this field, and commissioned as a major in the Signal Corps of the Army during the war. The Signal Corps also obtained the assistance of the Bureau of Standards.

To understand how it works, it is only necessary to witness some of the simple experiments. Take an arc lamp and put an opaque screen before it, shutting out the light, but transmitting the ultra-violet rays. Through an ordinary telescope you see nothing. But, by the use of a fluorescent screen in the telescope, you find that the ultra-violet rays from the arc lamp are distinctly visible. You see the light or lights behind the opaque surface. You could follow any system of signaling, while others, without the specially equipped telescope, see nothing. The opaque filter is transparent to the ultra-violet rays, but blocks the so-called white light.

The value of this for secret signaling is obvious. You could signal on the battle-field or between ships at sea without the enemy being aware of it. In a naval battle a ship's wireless might be shot away. It will now be instantly possible to use this method of secret signaling in place of the wireless.

The screen upon which the image is formed is made up of platinum barium cyanide or uranium sulphide.

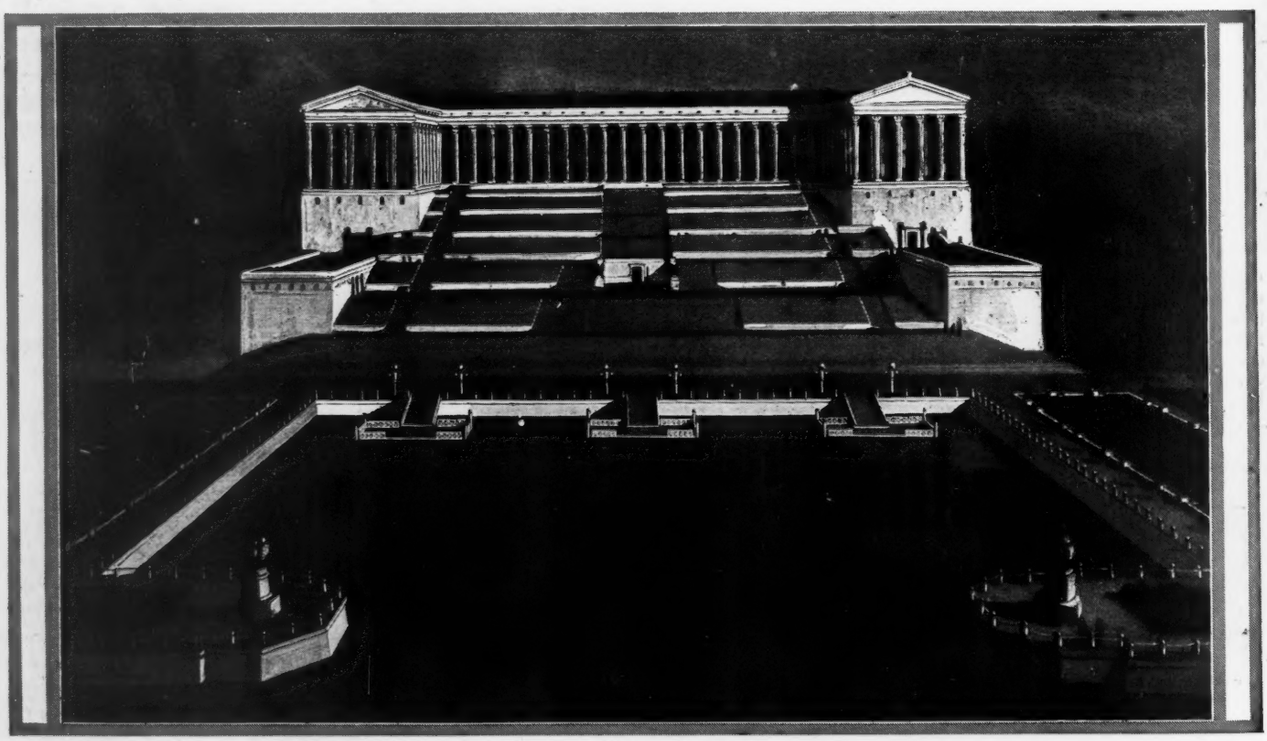
A Marble Water-Gate for New York City

WHEN we entertain, do we admit our guests through the back door, past garbage-cans, into the cellar, up the cellar stairs, and finally into the drawing-room? No, certainly not! Yet that is just how we as a nation treat our distinguished foreign guests. We dump them out on ill-smelling, noisy wharfs piled high with freight; then we drive them through ugly, crowded streets; and finally we take them up our Fifth Avenues to one of our Waldorf-Astorias. If first impressions count, what must they think?

Dreadful things, says H. Van Buren Magonigle, a well known architect; and so he has designed an elaborate water-gate for New York city. If the city decides to build it, it will be situated on the Hudson just in front of Cathedral Parkway.

Steps will lead up from it to the top of Riverside Park, terminating in one of the most beautiful sections of the city. Near by will be the Cathedral of Saint John the Divine, and just beyond it Central Park. The water-gate is designed to be made in marble and granite, and to be finished off as a war memorial. At the top there will be a naval museum on one side and a reception building on the other. These will be connected by rows of marble columns.

Then, when guests are not expected, the public might sit on the steps, watch the boats go by, and enjoy the summer breezes.



A great marble water-gate has been designed for New York city, it would be situated on the Hudson, and important foreign visitors would enter the country through it

How Hot or How Cold Is the Air?

WEATHER observations are even more important to an airship than to water-borne craft. Temperature has a great deal to do with the buoyancy of an airship. Here, however, we behold a paradox; for the officer in the picture below, prior to a flight, is carefully shading his thermometer from the rays of the sun before reading it, although his airship is going to be exposed to full sunshine.

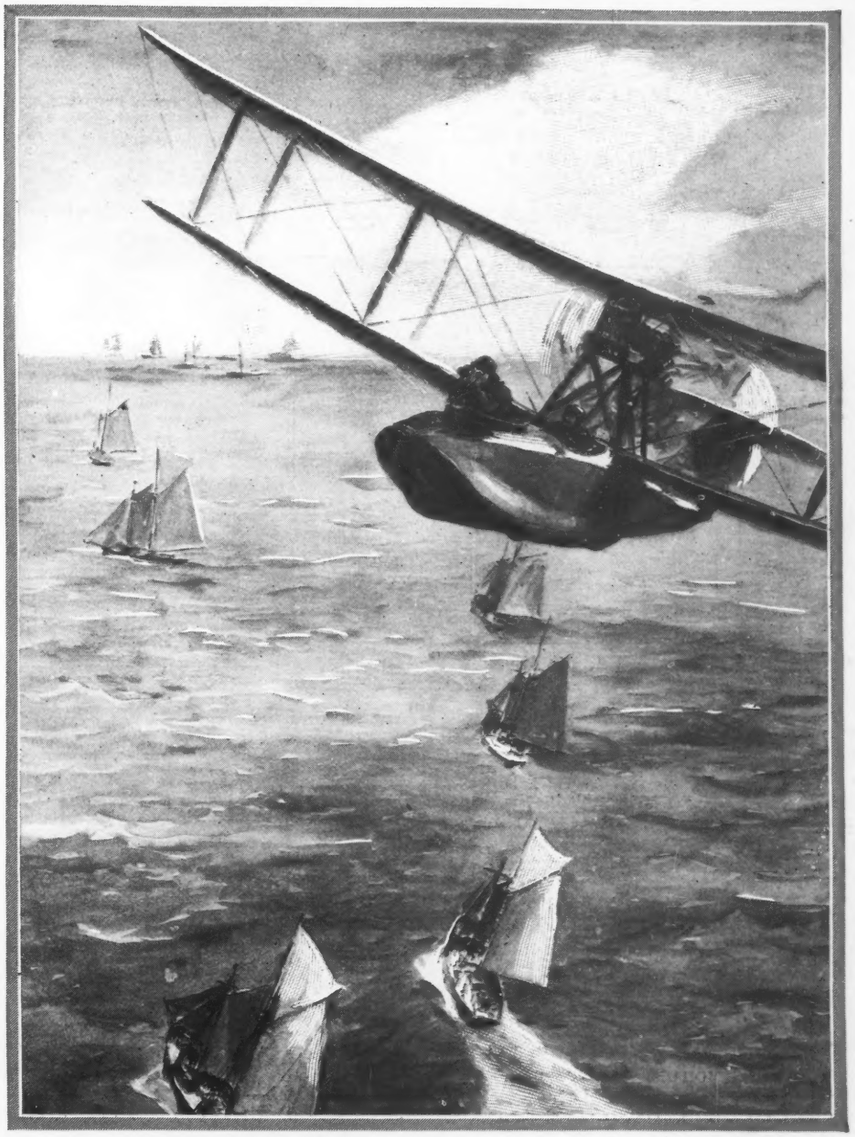
It is the same paradox that gives rise to indignation in the bosom of the average citizen when, at the close of a broiling July day, he reads the official weather report, according to which the highest temperature was only ninety. He feels positive it was at least a hundred—and so it was over a sun-baked pavement.

The universal practice of taking air temperatures in the shade is not sheer perversity on the part of the weather man. He would like to be able to answer the question, "How hot is it in the sun?" Unfortunately, this question merely prompts another: "How hot is *what* in the sun?" A thermometer exposed to the sunshine registers the temperature of the glass and metal of which it is made, not the temperature of the air.

The shaded thermometer registers more or less accurately the temperature of the *air*, perhaps the most important factor of weather. The thermometer shown in the picture is doubly protected by its wooden case. Perhaps there is also a ventilating device in the shape of a revolving fan.

An alternative to reading the thermometer in the shade is to whirl it rapidly in the air at the end of a cord. The excessive heat which the instrument absorbs is immediately lost by conduction to the air.

To tell the truth, the thermometer must keep cool—hence the sunshade



Instead of hunting submarines, this seaplane must now be content with hunting schools of mackerel

When Airplanes Go Fishing

Gloucester asks the Navy for forty flying-boats

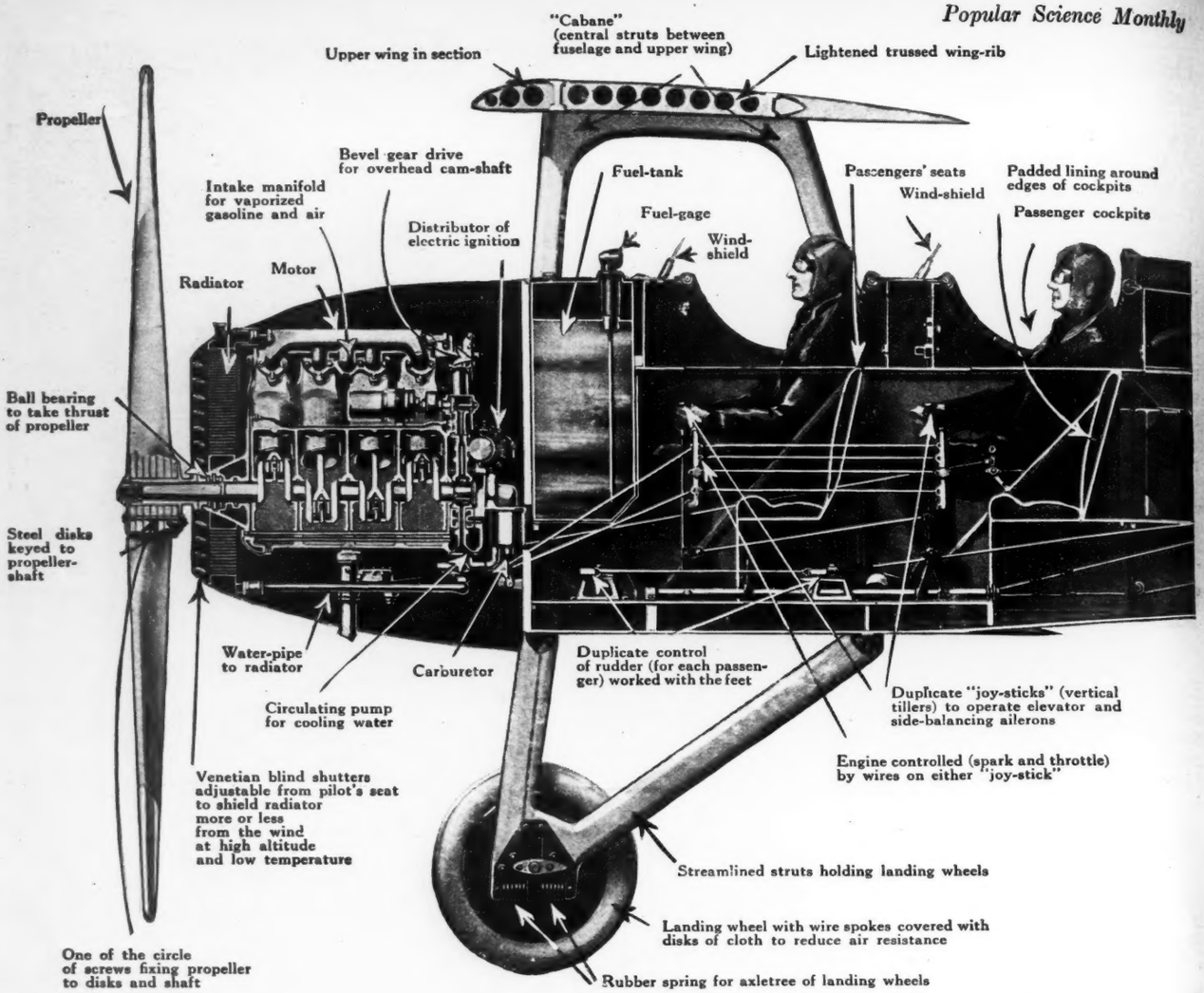
THE aviator, looking down into the still, clear water, saw a submarine sunning on the bottom of the ocean. He signaled a destroyer. She steamed up and dropped a depth-bomb. After the tumult had subsided, oil began to spread on the surface of the water: the U-boat had been blown to pieces.

That was the war-time job of the naval airplane. What will it do now? Hunt fish instead of submarines?

Every year forty fishing-schooners start out from Gloucester, Mass., in search of great schools of mackerel. Heretofore the custom has been to station a lookout on the foremast of each vessel. Presently one of the lookouts would sight a school of fish. Then the boats would close in, spread their nets, and haul in the fish.

These lookouts, who were stationed about thirty feet above the level of the water, could spot fish only within a radius of a mile or so. Think of the possibilities of an airplane flying three hundred feet up! One observer in an airplane could scan an area ten times as large as would be possible to the lookouts of a whole fishing fleet, and would save the boats much of the time that is usually wasted in cruising around.

The town of Gloucester has made a request of Secretary of the Navy Daniels to lend her a fleet of forty flying-boats.


"Cabane" (central struts between fuselage and upper wing)
Upper wing in section
Lightened trussed wing-rib
Propeller
Bevel gear drive for overhead cam-shaft
Intake manifold for vaporized gasoline and air
Fuel-tank
Passengers' seats
Wind-shield
Padded lining around edges of cockpits
Fuel-gage
Passenger cockpits
Distributor of electric ignition
Wind-shield
Motor
Radiator
Ball bearing to take thrust of propeller
Steel disks keyed to propeller-shaft
Water-pipe to radiator
Carburetor
Duplicate control of rudder (for each passenger) worked with the feet
Circulating pump for cooling water
Duplicate "joy-sticks" (vertical tillers) to operate elevator and side-balancing ailerons
Engine controlled (spark and throttle) by wires on either "joy-stick"
Venetian blind shutters adjustable from pilot's seat to shield radiator more or less from the wind at high altitude and low temperature
Streamlined struts holding landing wheels
Landing wheel with wire spokes covered with disks of cloth to reduce air resistance
One of the circle of screws fixing propeller to disks and shaft
Rubber spring for axletree of landing wheels

How the Airplane Is

The new clippers of the sky, like their ocean-born

REMEMBER the pictures over which you used to pore in the dictionary—wonderful cross-section views of line-of-battle ships, every gun-deck showing, and all the secrets of life on the deep revealed? Here is the same scheme applied to the airplane. Even the expert may like to see the things he knows thus visualized.

There appears a striking likeness between the airship of today and a steamship. The same trim, shapely hull, with rudder and propeller, is there, as is the engine-room with its familiar rows of cylinders. But the comparison shows that real mechanical efficiency has been more essential in the air than on the water. The shortness of the propeller-shaft and the location of the engine-room in the extreme front end are its visible evidence.

Its Enormous Propeller

On the other hand, the comparatively enormous size of the airplane's propeller makes it quite as noticeable that the hull (fuselage) of the airplane meets a relatively higher resistance in the air than the hull of the steamer meets in the water.

True, the airplane propeller has also to drive wings through the air; but the resistance, the so-called "drift" of the wings, although it furnishes the whole support in the air, is considerably less than that of the rest of the machine.

How Air Is Like Water

To understand why it takes so much power to drive the airplane hull, we need only to imagine it driven through water as a submarine is driven when submerged. At once we are struck with the awkwardness of the lower appendage—the frame sticking out for carrying the landing wheels.

We are so accustomed to make little of the effort it takes to drive small things through the air that this appendage did not worry us much, especially considering the attempt made to reduce its resistance by sharpening the struts and "disking" the wheels. But when we think of this appendage as on the bottom of a motor-boat we feel a strong desire to be rid of it.

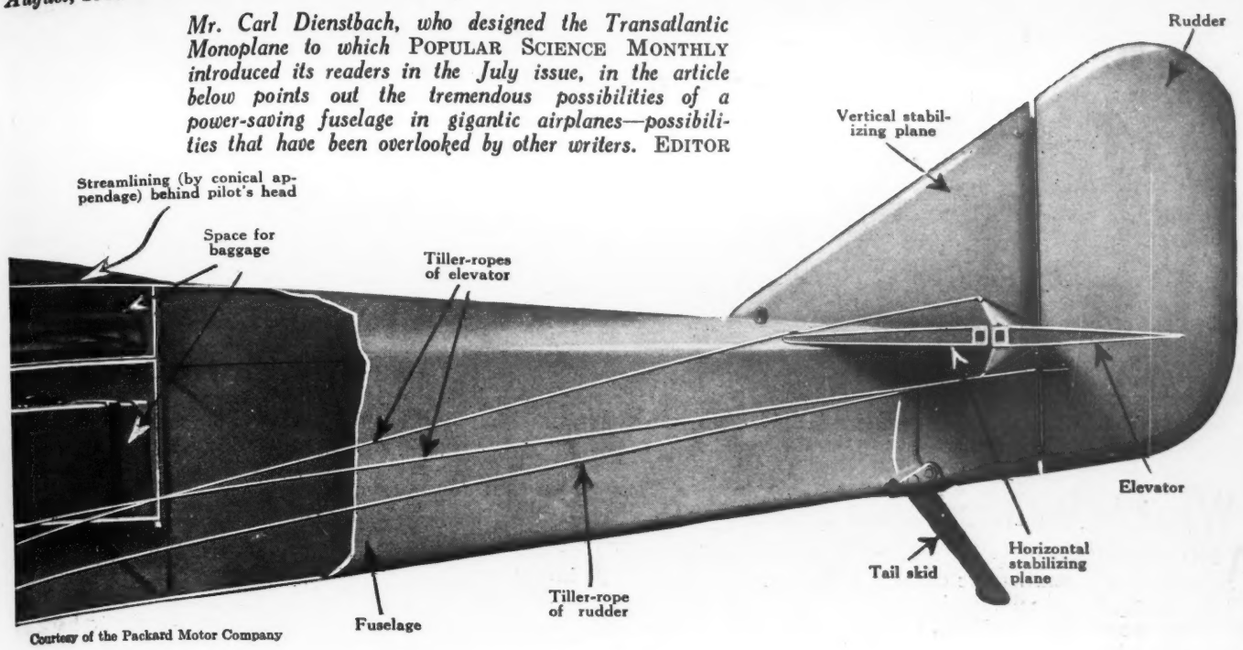
Who will be first to find a way of folding the landing gear into the hull during flight, as a gull on the wing tucks up its legs?

The instinctive carelessness about the resistance of things in the air led to those wasteful early designs in which engines, radiators, tanks, men, and what not were scattered over the lower surface and left exposed. Yet the Wright brothers and the Farman brothers were bicycle makers and riders, and might have been expected to remember the effect of a head-wind on pedaling, and the gain in speed in the well known experiment of building a streamline shell around the rider.

An All-Metal Machine

In addition to the landing-gear, the big open cockpits on top of the fuselage loom up as formidable obstacles to speed the moment we imagine the device

Mr. Carl Dienstbach, who designed the Transatlantic Monoplane to which POPULAR SCIENCE MONTHLY *introduced its readers in the July issue, in the article below points out the tremendous possibilities of a power-saving fuselage in gigantic airplanes—possibilities that have been overlooked by other writers.* EDITOR



Courtesy of the Packard Motor Company

IT is a far cry from the early airplane designs turned out by the Wrights and the Farmans—not so much in point of time as in point of progress—to the trim-bodied flyers of today. More and more the airplane takes on the proportions and appearance of a true ship of the air.

With the multiplication of parts and gear there has grown up a language of the air as unfamiliar to the landsman as is the salty talk of the deep-sea sailor. Yet "fuselage," "cabane," "joy-stick," "ailerons," and words of their brotherhood have taken out citizenship papers with the dictionary-makers. Soon we'll all be saying them.

It is to aid our readers to use them correctly, and to read with understanding, that we present this sectional view of a modern airplane with all of its secrets exposed and its parts named and explained.

Increasing Its Speed

sisters, owe their swiftness and power to hull design

submerged and moving through water. From the same point of view, the many struts and wires between biplane wings are seen at their proper negative value, and any design is welcomed which—like, for instance, the all-metal machine described on page 79 of the June issue of POPULAR SCIENCE MONTHLY—does away with these.

Merits of Large Airplanes

We get a still more direct grasp of the problem by remembering that if one raises his hand above the windshield of an airplane traveling ninety miles an hour (not at all a fast air speed) it feels exactly as if it had been dipped into the water from a fast motor-boat, so palpable is the resistance. Pondering this fact, we will be prepared to correct an oversight common to many who have discussed the merits or demerits of very large airplanes.

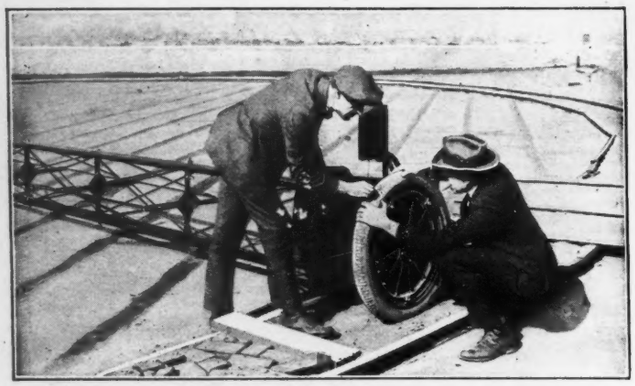
It has been endlessly repeated that, since the weight increases with the cube and the lift only with the square of the wing dimensions, large sizes offer nothing but difficulties. The critics forgot that, within limits, the faster you go the less wing-space you need, and that, while the power-saving of the fuselage increases with the cube, its cross-section or air resistance increases only with the square of its dimensions. In other words, if you make the airplane twice as large you can tuck away everything, except the wings and rudders and propellers, in a fuselage that requires comparatively a trifle more power to drive through the air than that of a machine half as big.

Motors in Separate Fuselages

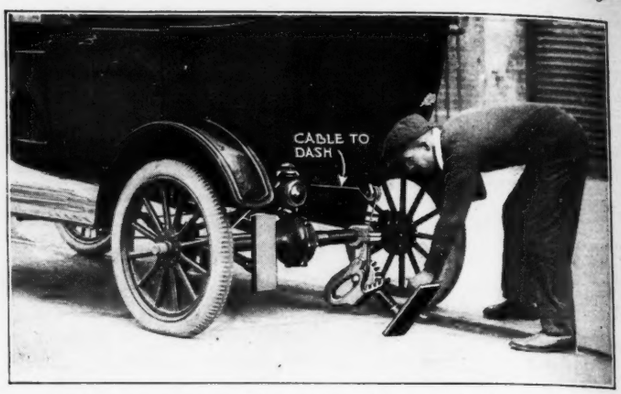
The designs of the larger machines—the Handley-Page, the big flying-boats, the Caproni, etc.—do not yet take proper advantage of the fact that, to a considerable extent, increase in size is as beneficial to an airplane as to a dirigible or a ship.

This advantage is shown indirectly by the fact that it has been possible to put the motors into separate fuselages on the large machines without as much detriment to efficiency as there would be in a small machine. The separate fuselages have, in their turn, also less resistance, relatively, when built on a large scale. It should be recalled, in this connection, that the discoverer of the vital part played by the fuselage was Nieuport, who deserves to rank with Lilienthal, Maxim, Langley, and the Wrights.

No picture can show all the progress that has been made in airplane designing, because the progress has been along the line of correct proportioning of all surfaces acting on the air, and correct distribution of weights and stresses. What is known about the correct proportioning of an airplane we owe to the modern air-tunnel, in which experiments are made with exact reproductions on a small scale of every existing or conceivable machine. It is exactly this proportioning which makes today's machines stable and airworthy in bad flying weather.



No defects in this company's tires, for one of each kind is first thoroughly tested upon this novel track



Jacking up a car in this manner has its drawbacks, for unless the driver is skilful the car is likely to overbalance

What Is Its Maximum Mileage?

A NOVEL method of testing automobile tires is employed by a manufacturing tire concern in Denver.

The track is half a mile in circumference, and it presents every feature of good and bad roads. An ingenious machine, with a long arm to which the tire is attached, propels the tire around the track.

A weight equivalent to that of a heavily loaded automobile is suspended over the tire in such a way that the tire itself carries the load. Once started on its journey, the tire continues to roll until it has given up its maximum amount of mileage.

The track is built upon the company's roof.

Jacking Tires Off the Ground

TO repair or change automobile tires, J. C. Drew, an inventor of New Orleans, would raise an automobile off the ground by providing four inclined-top jacks, two pivoted to each axle, and then reversing the car to back it up the inclined faces of the jacks.

Each jack is suspended from the axle by a forked lever with a horizontal transverse pin in bearings in the fork ends. A pinion gear is carried at the center of the pin between the forked ends, and the pin extended through the forks into slots inside of two wing members forming a part of the head of the jack. The head of the jack between the wing members has teeth meshing with those on the pinion gear.

Connecting the Trailer in Record Time

IN most forms of semi-trailers a great deal of time is wasted in connecting the trailer to the tractor or pulling vehicle.

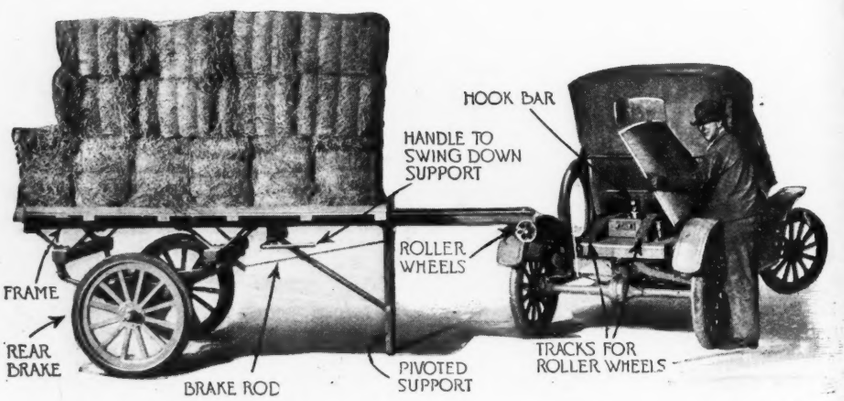
Most of the connecting gears are some form of fifth wheel, consisting of two horizontal circular bands of iron, one fitting on top of the other, with grease between and with a bolt or king-pin dropped through holes in the hubs or center bosses of both parts of the fifth wheel. The trouble in connecting both parts of the fifth wheel lies in the necessity of having the hole in the upper wheel boss directly above that in the lower wheel, so that the bolt can be dropped into the top member and down through the bottom member at one operation.

Since the semi-trailer is generally supported at its front end by a wooden horse during the loading operation, while the tractor is busy hauling another loaded trailer, backing up is often performed six or seven times before the king-pin can be dropped into place. Some form of fifth-wheel device is necessary to permit the trailer to swing about its point of attachment to the tractor when rounding corners, and to move up and down when going over hills.

Difficulties of this nature have been eliminated in a new form of fifth wheel in which the front end of the semi-trailer is mounted on two small roller wheels. These wheels are made to roll on two flanged tracks that are rigidly attached to the tractor frame. The tracks are made of angle-irons, with the vertical arm on the outside in each case, so that the wheels cannot slip out of the tracks. The latter are flared or widened out at their rear ends, so that, when the tractor is backed up, it can still be connected even if it is several inches out of line, provided the wheels touch the tracks anywhere inside the guiding vertical flanges of the angle-irons.

The locking of the semi-trailer is made in a new and novel manner. Instead of an ordinary king-pin, a vertical bar with a hook is used, the open end of the hook being to the rear. The shaft on which the two roller wheels are mounted fits into the hook and is locked into place by means of a longitudinal bar inserted between the top of the hook and a special roller mounted crosswise of the trailer frame above the roller wheel-shaft.

The vertical hooked bolt is mounted on a coil spring at its lower end to admit of up-and-down movement, and is further carried on two sets of horizontal coil springs placed longitudinally of the tractor frame to take up the starting and stopping strains.



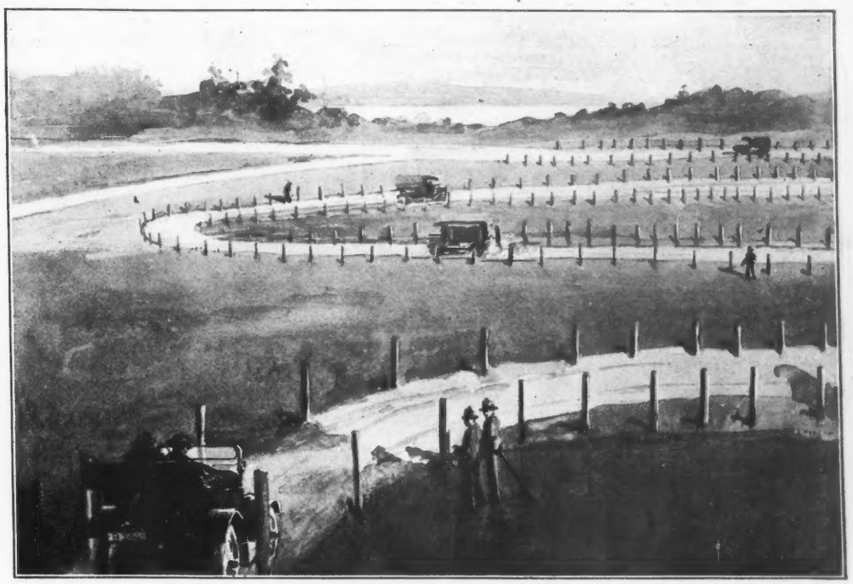
A prop for the two-wheeled trailer, together with a quickly detachable unit, have big advantages in the matter of time and labor

How the Government Rated Its War Truck-Drivers

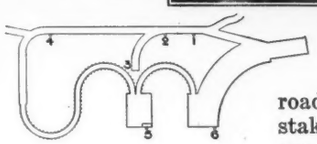
WITH the need for 92,550 truck-drivers for overseas duty soon after our entrance into the war, the Government decided to evolve some simple plan for rating each driver applicant. The test was divided into two parts—one an oral test and the other an actual driving test over the irregular-shaped course shown herewith.

Starting from the beginning of the test course is a straightaway to which the applicant must drive the truck. He takes it to post 1 with a scorer on the seat beside him. Then he runs down the road, turns off to the left on the curve to post 2, and runs to post 3, from which he must back up to the straightaway.

This gives the scorer opportunity to determine whether the applicant is sufficiently advanced to proceed with the balance of the test. If he is, he must then drive around the far end of the course and enter the S-shaped road, which is lined off on each side with stakes about four feet high and five feet apart. The road is very narrow, so that the driver must know how to steer so as to pass between the stakes without knocking any of them down.



To manipula e a heavy truck through the army test labyrinth requires fast brain work, steady nerves, and abundant strength



Coming out of the S curve, the driver must run his truck up frontways to the center of a board set up on stakes at post 5. Leaving that post, he must then back his vehicle around the semi-circular narrow road and to a second board supposed to represent a loading platform. The semi-circular road is also lined with stakes, which the driver must not knock down. From post 6 the driver must run uphill to the starting-point, stopping the truck on the hill and backing down to turn completely around, and he must do this without stalling the engine or grinding the gears.

The driver's skill between the consecutive posts is scored by means of points. There are twenty-four points in all. If the driver performs perfectly between each two posts, he is given one or two points. If he fails, he is given a 0 point for that particular part of the test. For making three or fewer failures a man is rated as an expert; for four to nine, a journeyman; for ten to fifteen failures, an apprentice; and for sixteen or more failures, a novice.

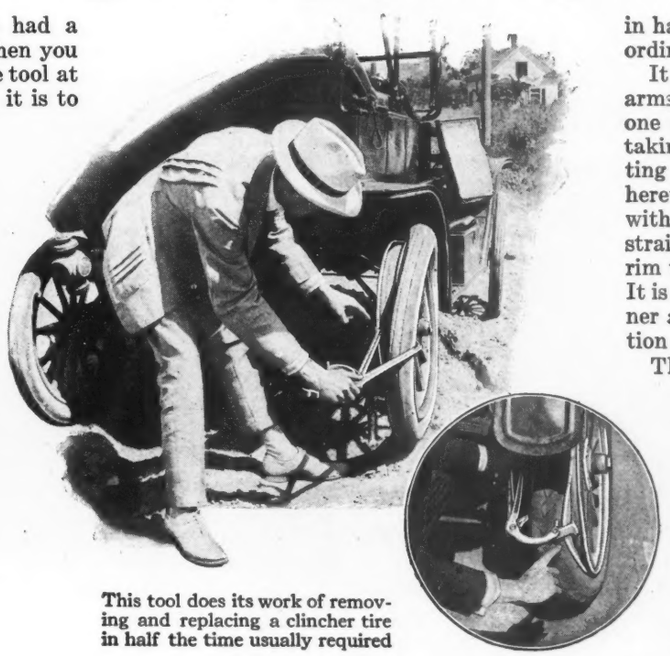
The total length of the course is 1,100 feet, of which 600 feet is the hill and staked-off portion. The Government officials in charge of the test consider that it was ninety per cent perfect, judging by results.

Off Again, On Again, Gone Again

THOSE of you who have had a blow-out on the road when you had unfortunately left your tire tool at home know exactly how hard it is to take off a clincher tire. Even with the ordinary tools it is a pretty hard job, and you are always glad when you make a run with no tire trouble.

Sometimes, rather than replace the tire, you pound along home on the rim of the car. This practice is one that should be avoided, for in some cases it necessitates purchasing a new rim, and in any case dents and bends the rim so that it must be hammered out again before the tire can be replaced.

A new quick-removal tire tool for clincher tires makes their removal easy, the operation being accomplished in half the time required with ordinary tools.



This tool does its work of removing and replacing a clincher tire in half the time usually required

It is formed of two curved arms, pivoted together at one end. The two steps in taking off the old tire and putting on a new one are shown herewith. The tire is gripped with the curved ends, one straight end resting against the rim to give a point of leverage. It is replaced in the same manner and the ease of the operation is astonishing.

The clincher tire naturally has its own peculiarities, and with the ordinary tire tools its removal is a long and tedious job, not to mention the usual result of skinned and bruised fingers. The tool described must be tried to be appreciated, and once used will thereafter always be carried in the car.

If You Have Tears, Prepare to Shed Them Now

It is plainly seen that when the picture above was taken, June Elvidge, movie star, was in no mood for tear registration; so her manager is applying small drops of ice water. This is but one of the many ways in which movie tears are manufactured

Like Niobe, all tears: these are real ones

The movie director's order for a strong, steady flow, accompanied by red eyes, is best filled by applying onion. Onion is not so pleasant as ice water, and so the accompanying expression is very apt to be more appropriate

"Hearts and Flowers"—the most popular movie form of what the Greeks called sob stuff—played on a violin by a long-haired, sad-eyed musician while the star is gathering force for a great emotional spill

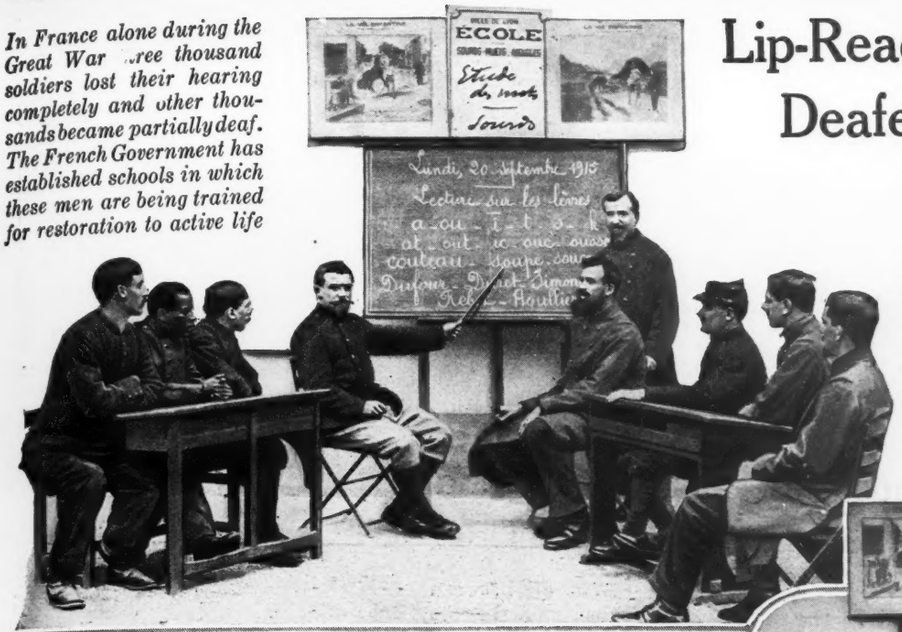
At the highest, saddest note she will almost always burst into real, wet, unaffected tears. If "Hearts and Flowers" won't do it, the next best choice is "The Curse of an Aching Heart"

Glycerine tears are administered with a medicine-dropper. They glisten in globules most convincingly, and are used entirely in many studios. What is more, these tears will last until the star is told to weep no more

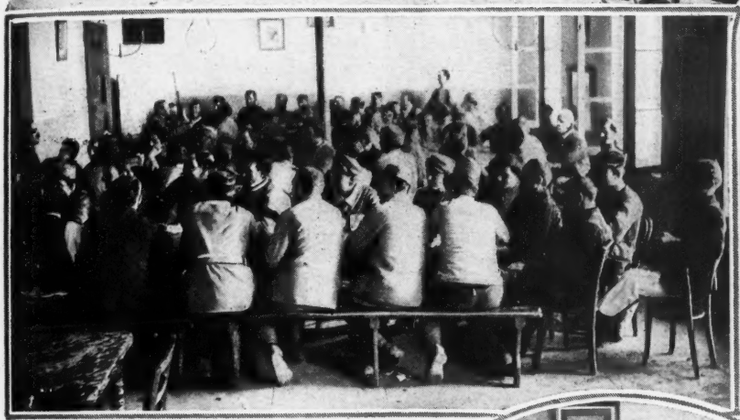
Relying on a star's emotions is a risky business. Here the manager is reading his star a letter from her absent sweetheart. Today she weeps: tomorrow she may meet an eligible millionaire and smile instead

Lip-Reading Taught to Deafened Soldiers

In France alone during the Great War three thousand soldiers lost their hearing completely and other thousands became partially deaf. The French Government has established schools in which these men are being trained for restoration to active life



Back to school, these French soldiers, who are totally deaf, are learning to read again the old familiar words. As the teacher points to each word and carefully pronounces it, they read his lips intently



All of these grown-up schoolboys went through the war at its worst. Some were made deaf by the ear-splitting noise of bursting shells and mines; others are deaf because of injuries to the skull. France has several schools like this

Not totally deaf are the men of this class, and so their instructor tries to bring back their hearing. The teacher is pronouncing a word close to a deaf man's ear, keeping his voice low and enunciating clearly

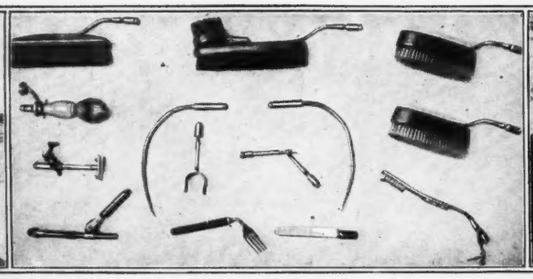
The teacher at the end of the table, who has bared his teeth in seeming ferociousness, is only pronouncing a slightly exaggerated *d*. Watching him very carefully, his pupils will soon learn the alphabet of lip-reading

"Right arm, up!" says the instructor, and up goes the student's right arm. It is examination day, and all the students who are not totally deaf are given an oral test

The eyelid test is one of the first tests given a patient, to determine the degree of his deafness. If the organs of hearing are not completely destroyed the eyelids will flicker when a noise-producing machine is applied to the ears

Photographs courtesy of *Carry On*

When the telephone rings in his office, this handless man uses his telephone hook and pen attachment



The butt ends of these implements all fit into the sockets of the wrist plates of the armless man, and with them he is able to dress himself, feed himself, and do his daily work

Shoestring comes loose? That's easy, with the right hooks

Without Hands, He Eats, Works, and Dresses Himself

How one man mastered a difficult situation

"WE will have to amputate your hands," the doctors told Mr. P. H. Knight, when he was taken to the hospital after an accident. He was thirty-four years old and had led a very active life.

"How dreadful," you say, "suddenly to become a helpless cripple!"

But was he helpless? Not for very long. As soon as he was discharged from the hospital, he learned to manipulate mechanical hands.

As his arms were cut off between the wrist and the elbow, he had made for him artificial arms which terminate in metal wrist plates. In the center of each wrist plate is a socket into which various implements fit. These are held in place by a spring catch.

What are these implements? A knife, a fork, a spoon, hooks, a hair-brush, tooth-brush, whisk-broom, blacking-brush, razor, lather-brush, toothpick, fountain-pen, match-holder, telephone-holder, and pencil-holder. Mr. Knight has learned to use all of them, and so has made himself almost entirely independent of the help of others.

He shaves, dresses himself, goes to his office, comes home and shakes down the furnace and then rocks the baby to sleep.

He is a really remarkable example of what a man can do under trying circumstances.

Those two white patches of adhesive tape on her nose help her hay fever by dilating her nostrils

Dilate Your Nose and Dodge Hay Fever

"KERCHOO!" sneezed a passenger on the White Mountain Express; and soon everybody was sneezing. They were hay fever victims on their way to the mountains for relief.

But they might have gone to William F. Sawyer, of Racine, Wisconsin, instead; for he has invented a nose dilator for the relief of hay fever.

It is made of two disks of adhesive tape connected by wire. You place the disks on either side of your nose and bend the wire band upward. With each breath the disks rise, dilating the nostrils and relieving the irritation.

A Chair that Matches One's Moods

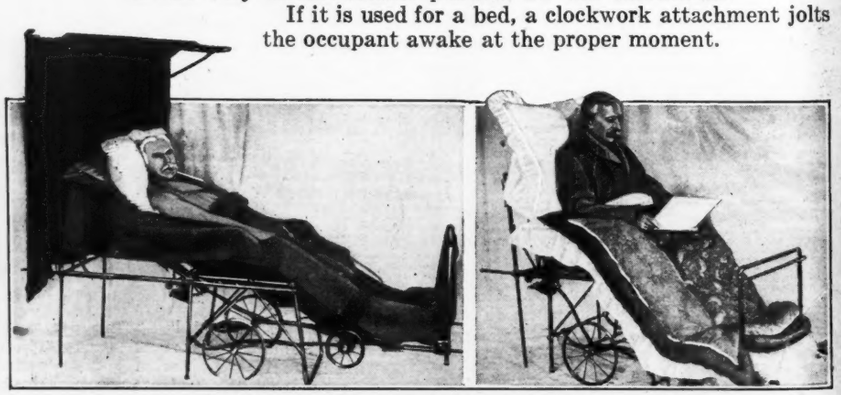
IT'S a queer chair that Jane Murray has invented. If you are working, you turn a lever or wheel and your bed becomes a business chair. If you wish to recline after having worked hard for an hour or so, another twist of the wrist and you lie on your back. Even a bath-chair can be made of this device at a moment's notice, or it can be turned into a first-class stretcher.

But it is not merely for lazy people that this chair-bed was invented. It is really of great value to an invalid, and its usefulness has been demonstrated in the case of wounded soldiers. The position of the patient can be changed at will, and without inconvenience or unnecessary pain.

You have seen the wheelers at seaside resorts. The chair is converted into one of them with the greatest ease. You merely fold this remarkable device into compact form and take it along with you on a week-end trip to the beach.

As an office chair the invention also has its good features. There is one very uncomfortable position for the unwelcome.

If it is used for a bed, a clockwork attachment jolts the occupant awake at the proper moment.



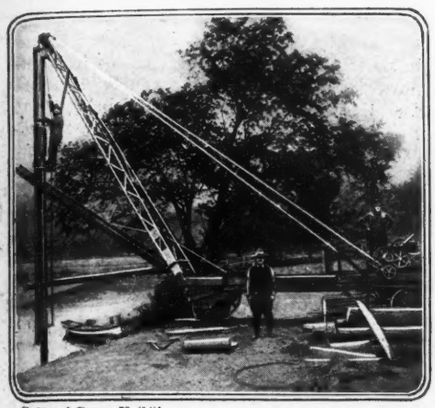
By moving a lever you change this chair into a bed, a stretcher, or even an uncomfortable chair for callers who stay too long

Making the Pile-Driver Handy and Portable

EVERYWHERE our soldiers went their base was sure to go. When they advanced, doctors, nurses, Y workers, cooks, and laundrymen packed up and followed, wheeling their equipment before them. For nearly everything in France traveled on wheels, even pile-drivers.

Below is a four-wheeled pile-driver making its debut in France. It is shown driving its first pile. All that was necessary to set it up was to block the wheels.

This pile-driver is built like any other except for its portability.



© Signal Corps, U. S. A.

Pile-drivers traveled on wheels in France to facilitate quick action

A Victory bridge for Niagara Falls—to have inscribed on it records of Canadians and Americans who fought in the war—has been proposed by Dr. T. K. Thomson

Bridges as War Memorials?

A VICTORY bridge for Niagara Falls and another one for Buffalo have been proposed by Dr. T. Kennard Thomson, a consulting engineer of New York. He has drawn up plans for building them should his proposal be accepted.

The bridge at Niagara would have a clear span of a thousand feet, with the roadway one hundred feet wide and one hundred and forty-five feet above the water. It would be made of massive steel trusses encased in concrete. The total cost of such a structure is estimated at not more than ten million dollars.

The plan for Buffalo's bridge is for one of six spans, since the water below is less violent than the water at Niagara. Each span would be three hundred feet long and the spans and approaches would measure in all about a mile.

This bridge, which would likewise be one hundred feet wide and cost ten million dollars, is planned to be built of rock-faced granite backed with concrete.

The idea seems to us a good one. What more fitting background for the commemoration of heroic deeds than a bridge of dignified architecture?

A Garbage-Disposal Plant Built on a Boat

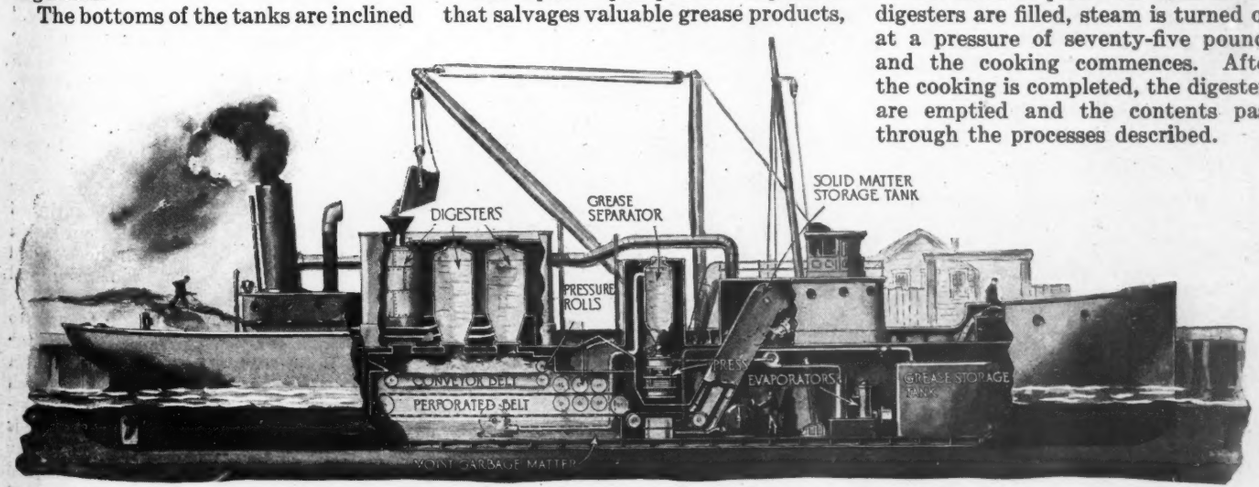
IN a recent design for a garbage-disposal plant, steam digesters or containers are arranged in batteries upon a suitable boat, which may be towed or proceed under its own power away from the collecting pier.

At the bottom of each digester are both steam and water connections from copious supplies, while beneath are the receiving tanks, each designed to receive the contents of six digesters.

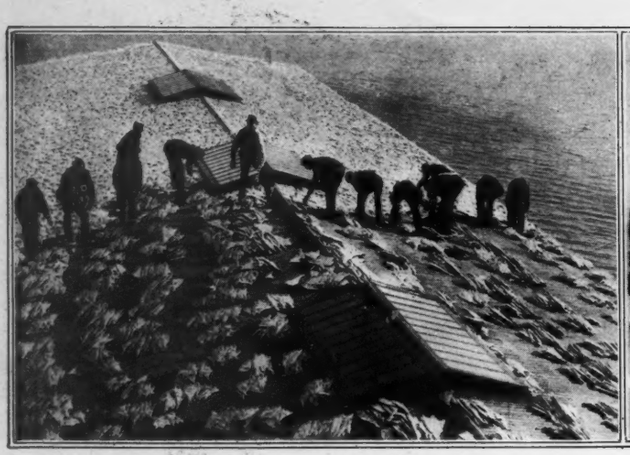
The bottoms of the tanks are inclined so as to guide the contents toward the center and through an outlet to a traveling belt passing between pressure rollers or crushers. From the rollers the mixture drops to a second belt, of steel, with perforations through which the liquid portion drains, while the solid matter passes on to an additional set of rollers and thence by means of a conveyor to a storage-room.

The liquid is pumped to a separator that salvages valuable grease products, after which the settlings may be pressed on cheesecloth by hydraulic power to further assist the recovery. Finally, the liquid may be evaporated or subjected to additional reclaiming processes.

Operation of the plant is simple. Garbage is dumped on the deck of the boat, whence it is transferred by a crane to the hoppers of the digesters. If desired, the crane may be located on the dock or pier. As soon as the digesters are filled, steam is turned on at a pressure of seventy-five pounds and the cooking commences. After the cooking is completed, the digesters are emptied and the contents pass through the processes described.



The garbage is dumped on the deck of the boat, and transferred by a crane to the digesters



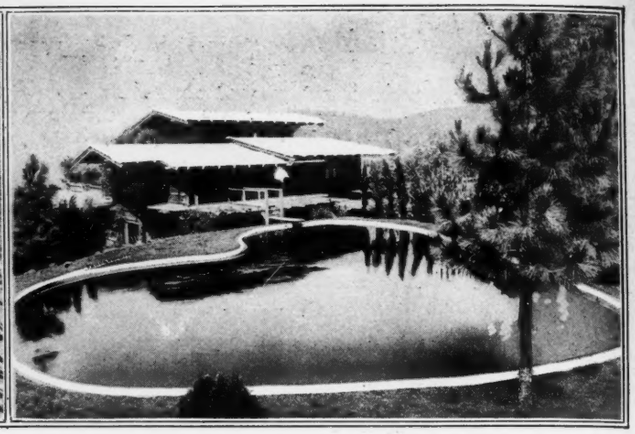
The Fish that Made Newfoundland Famous

NEWFOUNDLAND is the place where cod-liver oil comes from and transatlantic airplanes go from. But, in the recent excitement over trans-ocean flights, the cod-liver oil and the codfish that furnish it have been nearly forgotten by most of us.

Newfoundland has the greatest codfisheries in the world. The annual catch is estimated at two and a half million quintals—a quintal being one twentieth of a ton.

One half of this catch is exported, and its value is about six million dollars. Most of the cod is dried before it is exported. The illustration above shows a number of fishermen laying out cod to dry on the roof of a warehouse, quite undisturbed by the nearness of transatlantic planes.

Nearly all people in Newfoundland live by working for some branch of the great codfish business.



A Sentimentally Inclined Swimming-Pool

THE man who owns this watery heart calls forth our righteous envy. It is such a perfect swimming-pool. It lies just outside his bedroom window, and all he need do when he wants to swim is cross a small bridge, hop down three steps on to a springboard, and spring. No waiting in line for a dirty bath-house, no swallowing dirty salt water!

The water in this pool is fresh, cool, and flowing. It comes in through a well regulated pipe and goes out through another. The water is kept at a constant level just below the rim of the pool. The pool itself graduates from eighteen inches down to seven feet, accommodating both short and tall swimmers.

The distance from the springboard to the tip of the heart is forty-five feet. At its greatest width it measures approximately thirty-two feet.

The pool is both walled and floored with concrete.

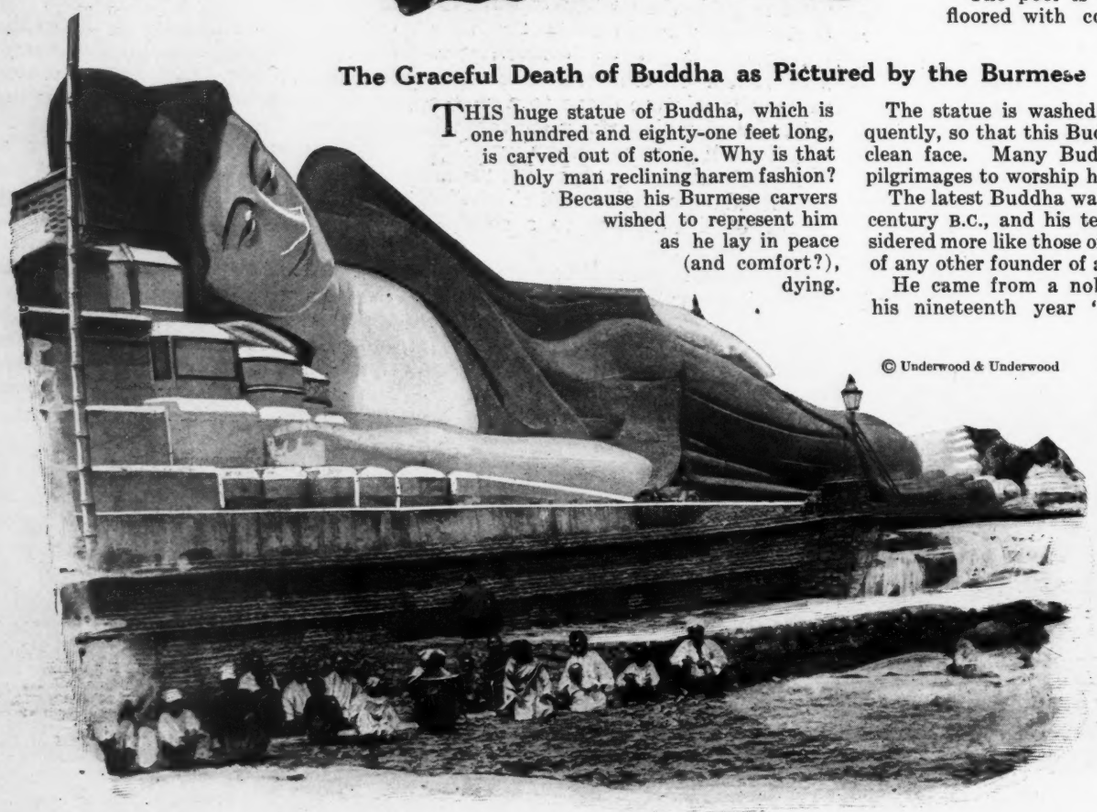
Choking the Life Out of a Telephone Wire

WISTARIA has proved herself quite out of the clinging-vine class. She is not a helpless plant dependent on some stronger growth, but, as the illustration below shows, a powerful vine that will slowly wind itself tighter and tighter about an innocent telephone wire and gradually choke it to death.

This telephone wire was strong and healthy when the vine started to creep around it. For the first year or so the vine wound itself loosely around the wire. Then it gradually tightened, gripping the wire so closely that dampness gathered between vine and wire, ruining the insulation.

The Graceful Death of Buddha as Pictured by the Burmese

THIS huge statue of Buddha, which is one hundred and eighty-one feet long, is carved out of stone. Why is that holy man reclining harem fashion? Because his Burmese carvers wished to represent him as he lay in peace (and comfort?), dying.



© Underwood & Underwood

The statue is washed and painted frequently, so that this Buddha always has a clean face. Many Buddhists make long pilgrimages to worship here.

The latest Buddha was born in the sixth century B.C., and his teachings are considered more like those of Christ than those of any other founder of a world religion.

He came from a noble family, and in his nineteenth year "married money." Whereupon he gave himself up to a life of luxury. But when he was twenty-nine he happened to see a feeble man broken down by age; he continued to see sad sights until he decided to go forth and help the world.

According to the belief of the Buddhists, a Buddha (which means "enlightened one") is born whenever the world has reached a certain stage of corruptness.

He Seems to be a Human Honeysuckle

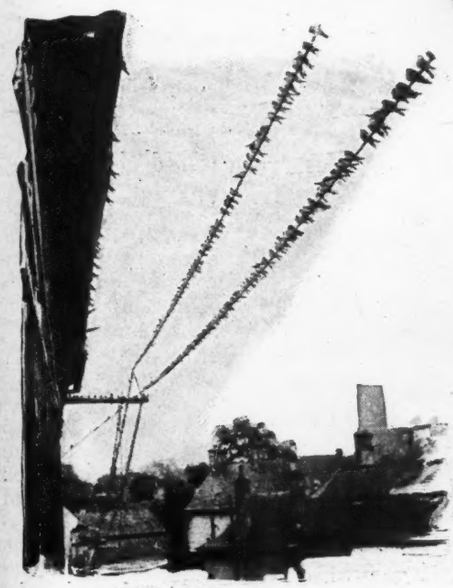
SERGEANT Charles Haberkorn and Orderly M. J. Maw, of the National Home for Disabled Soldiers at Sawtelle, Cal., have what is probably the only trained humming-bird in existence.

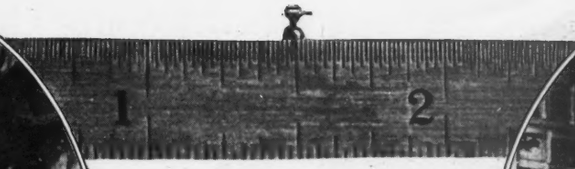
It lives in an orange tree but eats its meals from a medicine-dropper filled with sugar syrup.

The bird is shown apparently perching on thin air; but that is a trick the camera played.

The Swallows Stuck

THE swallows of Soissons never knew there was a war, or, if they did, they never let it upset them. All through the four years they lived there part of the time, leaving for northern Africa in the autumn and coming back every spring. Perhaps they noticed the change in diet when the Germans went out and the French came in.





A Turbine the Size of a Pin-Head.

BALANCING on a ruler's edge is the world's smallest turbine. Its base measures less than a sixteenth of an inch, and the whole thing weighs but 12 milligrams.

The rotor is made of steel, and measures not quite one thirty-second of an inch in diameter, the shaft seven thousandths of an inch.

It is too small to be operated by steam, and so it gets its power from an air hose.

A Policeman in the Spot-Light

WHEN utility and beauty clash, in the streets of Washington, D. C., usefulness is apt to get the worst of it. For instance, no lights but those enshrined in beautiful lamp-posts are allowed to shine at night; as a result, the useful traffic cop at bad corners is kept in the dark.

But the policeman at the corner of Fifteenth street and Pennsylvania avenue is taking no chances of being run down. He stands on a platform surrounded by a sheet-iron fence painted white. At night a searchlight is focused on him from a roof.

Where Nelson Is Only a Figurehead

QUITE a history goes with this figure of Admiral Nelson, which looks at the world with an innocent, wide-eyed wonder quite out of keeping with the doughty Admiral.

The bust was carved out of oak nearly a century ago, and was placed on the prow of the English ship *Ambassador*. On a trip to Nova Scotia, the *Ambassador* was lost—all except the figurehead, which has been treasured carefully ever since.

Sea-Gulls to the Rescue

TWO sea-gulls, weighing two hundred and fifty pounds each (they are bronze), are perched on top of a granite monument in Salt Lake City. The monument was erected in memory of a flock of sea-gulls which saved the original Mormon colony there from starvation.

In the colony's early days thousands of crickets attacked the tender crops. Then came the sea-gulls and ate the crickets up.

These beetles are carrying on a gas attack

Gas Attacks? Beetles Invented Them Millions of Years Ago

THE Germans have not the glory of being the original gas-attackers; for a certain kind of beetle has been gassing its enemies for centuries. When it sees a gargoyle-like creature, like the one in the illustration, it promptly ejects an explosive fluid from the last ring on its abdomen.

This fluid smells very much like nitric acid, and consequently is a great help to the beetle in its battle for existence. Perhaps, if Germany ever tabulates excuses for her atrocities, she will list the use of gas-bombs as a natural method of defense.

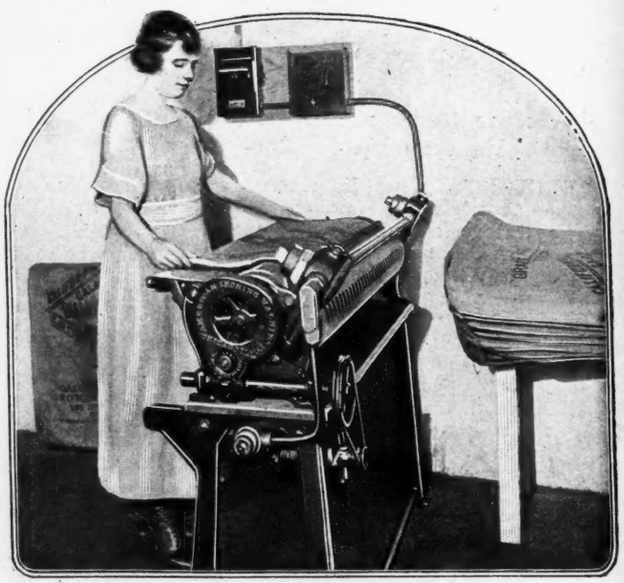
Ironing Out the Moths

CRACK! You open a walnut. Its meat is brown and shriveled; for a worm got there first. But how and when? Some California walnut-growers learned this.

When it was an egg, its mother—a moth living in the folds of a gunny-sack—laid it on the shell of your walnut, which was stored in that same sack. After it was hatched—deserted by its mother—it grew hungry and bored its way through the nut to get its first meal.

When the walnut-growers discovered this, they immediately sought a way to foil moth and child. First they treated the bags in chests of live steam. This proved successful but very expensive; for a large number of the steamed bags rotted because of insufficient drying.

Then they tried ironing the bags through electrically heated laundry manglers. The moths and eggs were destroyed, and the bags came out ready for use. The process saves thousands of dollars' worth of nuts yearly.



She is ironing moths out of gunny-sacks in which walnuts will be put; this keeps the nuts from getting wormy

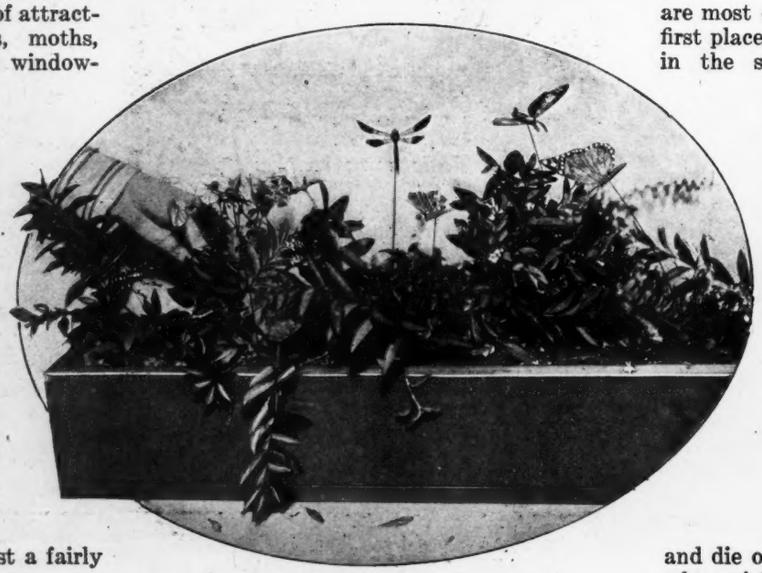
Artificial Butterflies for City Window-Boxes

IF you have despaired of attracting bees, butterflies, moths, and dragonflies to your window-box, accept this next best bet. Have artificial ones like those in the accompanying illustration. They sway in the breeze and add attractiveness to the plants in your box.

These insects are made of celluloid, and are mounted on fine spiral wires, which in turn are attached to wooden pins. These pins are stuck into the dirt in the box. The wire supports are so fine that they are barely visible against a fairly dark background.

The celluloid bugs themselves are most carefully made. In the first place, they are life-sized, and in the second place they are colored according to nature. The beetles have their blue-tipped wings and the butterflies their webbing and their spots. Nearly all kinds of summer bugs are represented in this collection. In our illustration, a mysterious hand is fearlessly adjusting a bee.

A pleasing feature about these artificial bugs is that they are confined to the box and won't be tempted to fly into your house and die on the dining-room table when night comes and the lights are lit.



These celluloid moths and dragonflies look real and won't fly away

Sit Up Front and Enjoy the Movies

"SEATS up front," says the usher as you enter the moving-picture theater.

But if you sit too near a moving picture the screen folk become monstrous, distorted figures moving around amid a great flickering that hurts the eyes.

If you are in the habit of arriving late, you ought to own a pair of the moving-picture spectacles invented by Edward Lamphier, of Kalamazoo, Michigan.

They are made like opera-glasses, but they have the reverse effect. Opera-glasses bring things near; these glasses send things away. Converging lenses are mounted on the outside ends of the frames, and the eye-pieces are adjustably mounted on aluminum tubes within.

The movie fan adjusts the eye-ieces to suit his particular focal length. A screen fifteen feet away will then seem to be forty-five feet away and flickering is reduced.

Moving-picture spectacles will make a screen that is fifteen feet away appear to be three times that distance off

Primitive Iron-Smelting at the Present Day

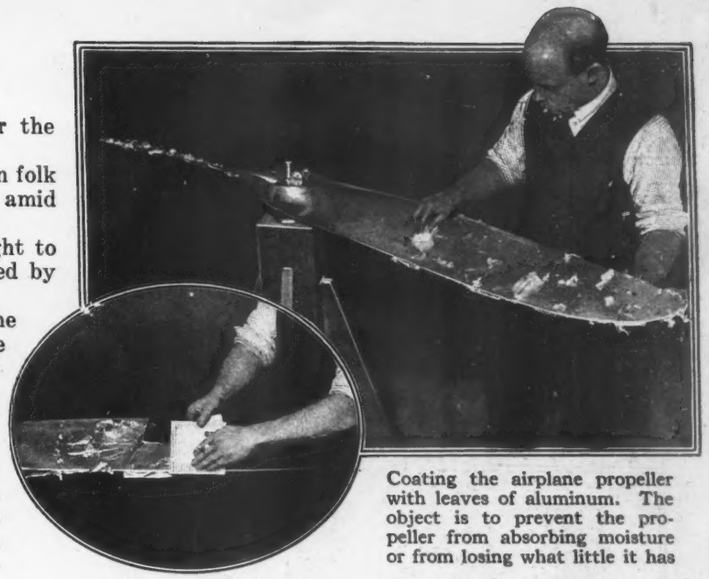
IT is difficult to believe that iron ore is being smelted by primitive methods in these days. But the photograph shown herewith, taken recently at Kazombo, Africa, shows how the natives of Rhodesia carry on that operation.

The entire structure is built of earth taken from an ant-hill, made into mud, and dried. The upright conical part is hollow. The projection set at an inclined angle is concave and leads to the central hollow. A hole is made in the base of the cone for the bellows nozzle, while slots are made to create a free blast.

A fire is started in the base and small pieces of charcoal and iron ore placed on the "tray" and in the hole. The blast is kept up incessantly by relays of natives from early morning till evening, when the bars are broken down and a large mass of red-hot metal is found mixed with charcoal. The more or less pure iron is found at the center of this mass. This is cut into smaller pieces, softened by fire, and made into axes, hoes, knives, etc.

The bellows are as ingenious as they are primitive. Imagine four large tobacco-pipe bowls leading to one stem. Antelope skin is tied over each bowl and to the center of each skin is attached a stick. The blast is obtained by a series of up-and-down movements of the stick.

The natives, working in relays of two, keep the blast going incessantly from morning till night



Coating the airplane propeller with leaves of aluminum. The object is to prevent the propeller from absorbing moisture or from losing what little it has

An Aluminum Coat for the Airplane Propeller

THE propeller of an airplane is as sensitive as any living human being. In the dry altitude of the Mexican border, of northern Africa, of India, and of Bagdad, days are hot and nights are cold. Hence propellers buckle, warp, and fall apart in the air. Propellers for use in the tropics were made on the spot during the war. This was inconvenient—how could it be avoided?

The Forest Products Laboratory, of Madison, Wisconsin, in cooperation with the University of Wisconsin, made a scientific investigation. Ordinary spar varnishes do not prevent the propeller from absorbing moisture or prevent it from losing what little moisture it has. The propeller becomes unbalanced; the pitch angles are changed. The result of the investigation has been the discovery of the aluminum-leaf spirit varnish process.

Step into the factory and watch the men coating propellers according to the instructions of the Forest Products Laboratory. They first sand the surface until it becomes wonderfully smooth, and fill the pores with a special wood filler. Aluminum leaf, thinner than this sheet of paper, is then applied to the propeller. To make the aluminum leaf stick to the propeller, a size—seventy-five per cent airplane spar varnish and twenty-five per cent turpentine—is brushed sparingly and evenly over the propeller.

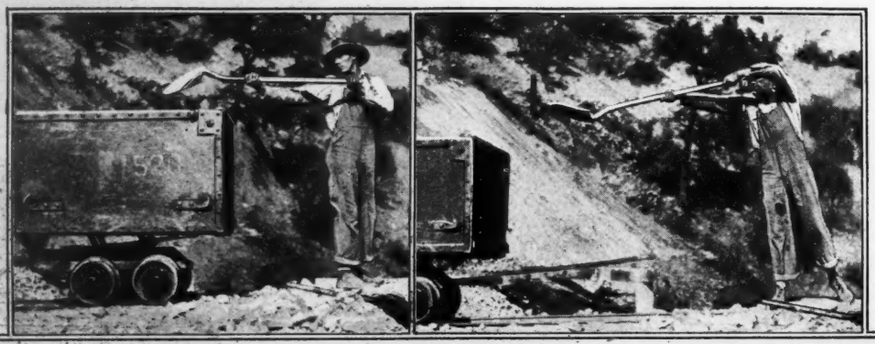
Watch the man applying the leaf. He takes a book containing leaves of aluminum—shining squares of from four to five and a half inches. The artisan turns the first page of the book half way, grasping it between the fingers, so that a whole leaf touches the sticky surface. In forty minutes the entire surface is covered.

Is the propeller finished? Not yet. Two coats of shellac varnish are now applied, and then the flowing coat of airplane spar varnish. When that dries, after forty-eight hours, the propeller is finished.

The Forest Products Laboratory claims that its process is practically one hundred per cent effective in preventing absorption of water, particularly in the storage stage.

How Brains Helped Brawn with the Shovel

Something more than brute force is necessary for the man who wields pick or shovel. G. Townsend Harley, an engineer, has worked out the technique of the shovel. This is the proper position when throwing ore into a car with a long-handled shovel



Compare this picture with its companion picture to the left, and notice the increased effort that is necessary in throwing the ore at long distance. Mr. Harley has discovered that shoveling speed decreases two and a half per cent for every foot of increased distance

This is the right way to start in with a short-handled shovel

The short-handled shovel artist: he has just lifted up a load from the pile

Showing the proper position after the shoveler has penetrated the mass he is attacking

Now he is ready to lift and throw a generous shovelful

The strained position at the end of the throw is due to attempting distance with a short-handled shovel

Long-handled shovel lifting position. Contrast this with the picture above of action with a short-handled implement

Preparing to throw with a long-handled shovel: a short step is taken in the direction of the throw

Delivery with the long-handled shovel. Note the ease of position as compared with that pictured above

Position when starting work with the long-handled shovel. Contrast with the short-handled series

Note the easy position of the workman as he pushes home his efficient long-handled shovel

This is the wrong way to start lifting: notice that the right hand and foot have been moved forward

Making a Sledge-Hammer of Your Hand

Posed and described for POPULAR SCIENCE MONTHLY
by Benny Leonard, world's champion light-weight

Time! Benny Leonard as the gong clangs. The hands within the gloves are insured for $20,000, and to protect them he bandages them carefully. He explains his system in these pictures

"I wind a piece of gauze, two inches wide and five feet long, about my hands, beginning at the knuckles and finishing at the wrists. Then come four pieces of eight-inch-long adhesive tape to hold the bandage firmly in place"

Two of the pieces of adhesive tape are crossed on the back of the hand from knuckles to wrist, and two are bound around the hand at wrist and knuckles, the ends of the tapes being lapped about an inch on the inside of the hand

The champion's right as it looks clenched within the glove. The bandage "sets" as the fist is closed, making an effective punch. Ask anyone who has heard the referee's slumber song: "—nine! ten! You're out!"

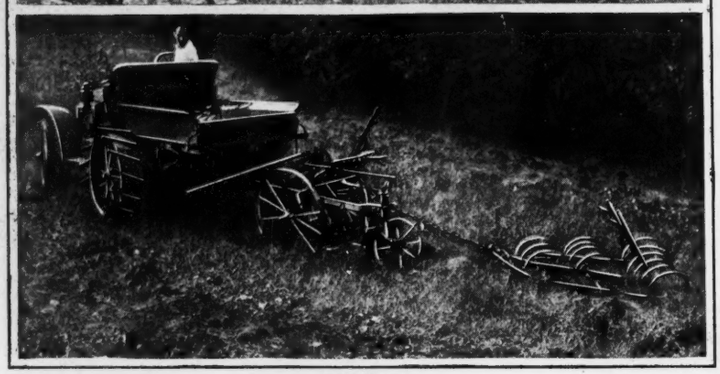
The bandaging should be done with the hand open as shown in this picture, which also shows how the hand looks on the inside. The thumb is not bound, because a boxer never hits with his thumb; he'd break it if he did

He Made a Tractor of His Second-Hand Car

THIS is not one of the stunts that anybody with a tool-box and a liking for machinery can perform; but POPULAR SCIENCE MONTHLY, having in its June and July issues shown some of the uses to which old or disabled automobiles can be put, feels bound to tell what Charles Mitchell, of Millbrook, N. Y., did with an ancient car not yet quite ready for the bone-yard.

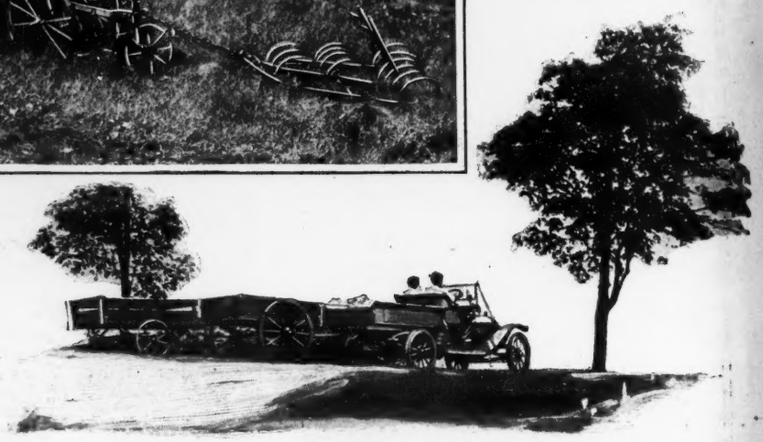
Mr. Mitchell's hobby is farming, and he wanted to do the thing right with tractors and all sorts of modern farm machinery. Shopping around for a tractor, he found that he couldn't get what he wanted under fifteen hundred dollars.

Now, Mr. Mitchell is by profession a consulting engineer, and he decided to make his own tractor. He bought a second-hand automobile for two hundred dollars, spent another hundred for a pair of tractor wheels and attachments, and then began to rig up the superannuated automobile.



When he had everything ship-shape he hitched a plow on behind, and found that his improvised tractor would turn up the soil in great shape. He trailed a harrow on behind the plow, and that worked too. Next Mr. Mitchell hoisted a spraying tank and pump into the back of his auto-tractor, climbed a 45-degree hill, and put the bugs to flight in his orchard.

Mr. Mitchell says he has used his home-made tractor for every kind of farm work except milking the cows.



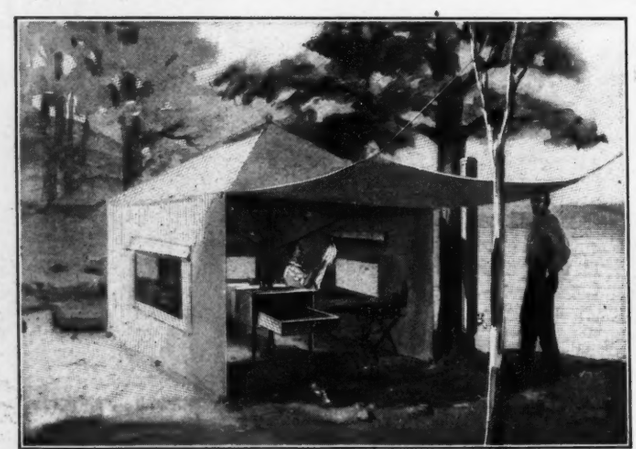
This home-made tractor, which cost only three hundred dollars, will do all kinds of farm-work, from spraying trees to plowing and harrowing; and it clings to the side of a 45-degree hill like a burr

Umbrella by Day—Tent by Night

LIVES there a man with soul so dead who never to himself hath said, "I'll go to the woods this summer"? If so, he need only glance at the tent in the accompanying photograph to have his soul livened up. It adapts itself to the weather and the time of day, as well as to the mood of the camper.

If the day is warm and bright, so that four walls—even tent walls—seem too confining, the sides of this tent may be unbuttoned from the roof cover and folded away in the box in which they came. Only a canopy now remains to keep out the glaring sunshine. This canopy shelters a small table, which is nothing more nor less than the packing-box provided with four legs. The center pole of the tent passes directly through the box, and box and pole mutually brace each other up.

This brace-table-box is made in such a way that one portion of it may be used as a drawer. If the sun should beat too strongly into one side of the tent space, the ribs supporting the roof cover on that side may be lowered.

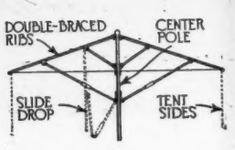


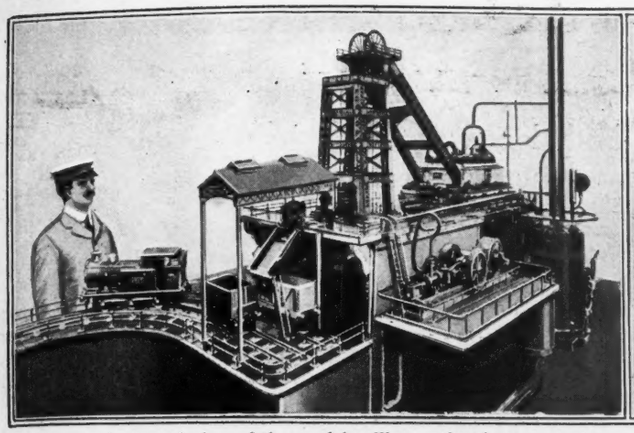
The tent's side walls are easily removed, leaving merely a canopy when desired; the table is a converted packing-box

The side walls are readily readjusted when it is desired to convert the umbrella into a tent again. To hold them down, a rope is passed through eyelets along the bottom of the four sides, forming loops through which the tent-pins are driven.

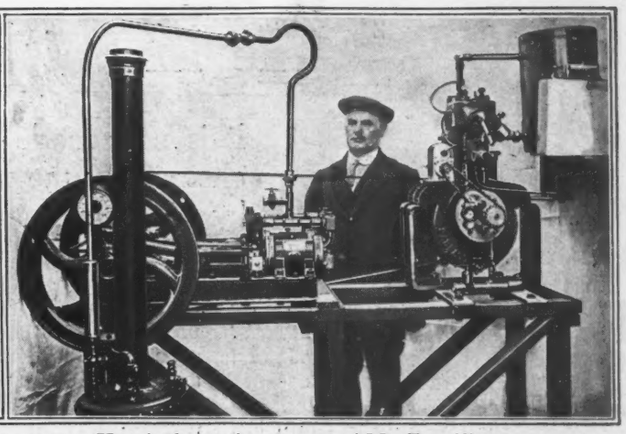
There are isinglass windows in two sides and the back, and a door in the front. A rain-strip is stitched to the wall above each window, and this is backed up on the inside by a curtain, which may be rolled up. The door is a flap of the tent material, and it also may be rolled up.

If the camp is not pitched near water, the metal cylinder in which the poles were carried may be used as a water container.





A general view of the model colliery—showing everything except the dock and the steamer



Here is the motive power and Mr. Tom Thomas, who has conceived and constructed the model

A Miniature Colliery: How One Welshman Used His Spare Time

WHAT would you say if you could see a whole colliery at work right indoors under a roof? This amazing construction actually exists; and, fittingly enough, it is in Wales—land of mountains and coal—that it was made.

The model colliery represents the ingenuity and spare time of Mr. Tom Thomas, of Llanelly, Wales, for the last thirty years. It is a stupendous work for one man to have accomplished. Mr. Thomas says it kept him out of a heap of mischief—and we believe him.

The model is complete in every respect, and shows the whole operation of a colliery, from the mining of the coal to the loading of it on the ships. The model is built of brass, steel, and copper, and is, as far as possible, a scale model.

Motive power is furnished by an old single-cylinder, eight-horsepower Darracq engine, which operates an air compressor. The compressed air is used to operate the various machines; for they "work," all of them.

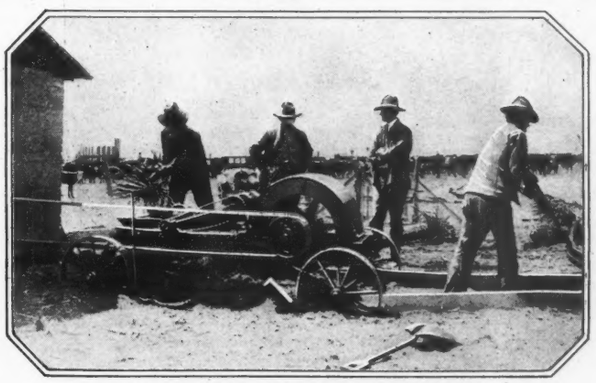
The hoisting machinery is controlled by an ingenious mechanical engine-driver, who stands with the control levers in his hands, running the machinery and sending signals to the locomotive engineer in a most uncannily human fashion. The model includes a locomotive and trucks, which run over a viaduct and through a tunnel to a model steamer at a dock.

Shredded Soapweed for Cattle

DOWN in the desert regions of New Mexico, cattle were starving to death by the hundreds last summer; there was no food to be had.

Of course, there were plenty of desert plants growing there,—sotol, soapweed, bear-grass, Spanish bayonet,—but cattle could not eat them because they were too thick and tough.

But the ranchmen were desperate, and so they rigged up a machine for shredding these plants into silage and thereby saved the lives of many cattle.



The weeds are fed to a chopping-block and revolving knives chop them up

The machine consists of a heavy cylinder provided with cutting knives. The cylinder-shaft is driven by a twelve-horsepower engine. The knives pass over a chopping-block which is parallel to the shaft.

The plants are fed into the machine horizontally. They pass on to the chopping-block, are cut up by the knives, and come out in shreds. Three men can chop twenty tons of soapweed in a day.

It is said that the ranchmen are enthusiastic about this new cattle fodder.

Hacking down tough soapweeds that will later be shredded into cattle silage: this fodder saved many cattle in New Mexico

The Life of a Clay Pigeon

It is now made both longer and cheaper by the machine invented by a Western gun club manager

IF one clay pigeon costs one cent, how much will 350,000 clay pigeons cost? That simple problem bothered Mr. Fred H. Teeple, of Los Angeles—not arithmetically, but economically. As manager of the Los Angeles Gun Club he realized that he was spending $3,500 a year on clay pigeons! An enormous sum, yet unavoidable, since the pigeons were shipped from the East and express rates were high. So Mr. Teeple decided to make his own pigeons.

He retired to a small wooden shed on the club grounds, and there built a machine that will turn out 4,000 birds a day at very low cost. It looks like the baby brother of a caterpillar tractor, and Mr. Teeple confirms the relationship by admitting that he got his idea from watching a tractor drawing a plow in a near-by field.

The Pigeons Are Hollow

The pigeon molds are fastened in pairs on each of the fourteen links of a pointed conveyor belt. Hot liquid clay dipped up from a tank is poured into these molds. They are filled half way. Then forms are lowered into the molds, forcing the liquid up around the sides in order to make the pigeons hollow and of uniform thickness. The clay hardens rapidly, and when the forms are raised the clay keeps its shape.

Then the operator pulls a lever, and the links all advance their length. The next pair of molds is then filled. In this way, by the time the first molds reach the bend the pigeons within are quite hard. An automatic knockout drops them out, and a boy picks them up. The molds continue on and underneath, passing through a pan of water and being thoroughly cooled.

Consistency of the Clay

The vat of liquid is kept at the boiling-point by a furnace below, in which oil is burned. An electric blast is also used. The liquid of which the pigeons are made consists of gypsum filler, hard pitch, and rosin, so proportioned that the finished pigeons will not be affected by extreme hot or cold weather, and yet will be sufficiently brittle to break readily when hit by shot.

Gypsum is a mineral that is soft and plastic in its natural state. When it is heated so that about seventy-five per cent of the water in it evaporates, it turns into "plaster of Paris," which is widely used in making casts. Pigeon clay is easily molded, owing to the gypsum. Pitch gives it its tenacity, and rosin its brittleness.

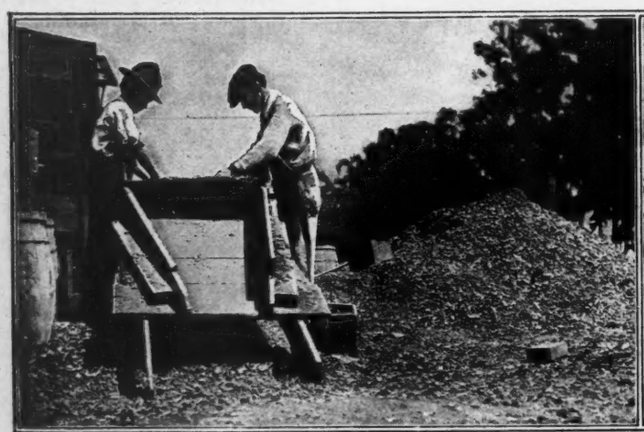
The pigeons are four and one half inches in diameter, one inch high, and each one weighs one sixth of a pound. Being hollow, they weigh very little and yet are large enough for the shooters to hit.

Though at present the pigeons are painted by hand, this will not long be the case. Mr. Teeple is building an automatic painter on which the birds will revolve on bobbins as stationary brushes paint them a glossy black with a yellow rim around the top edge.

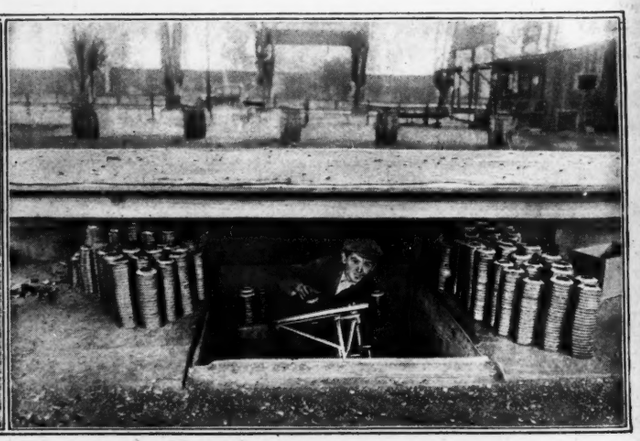
Here are some of the thousands of pigeons made each year at the Los Angeles Gun Club

Why They Are Cheaper

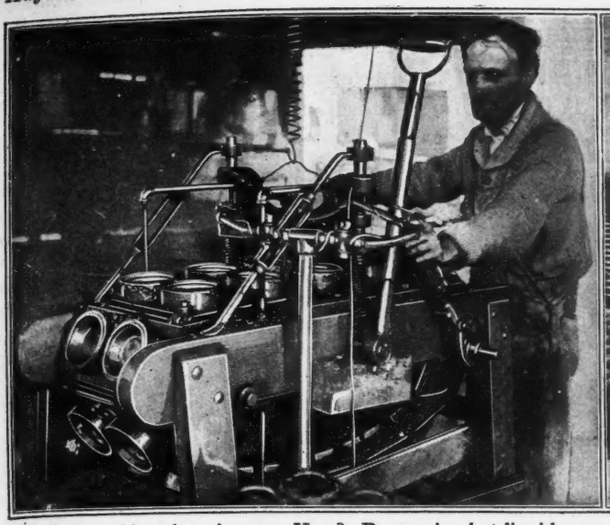
The great economy of the pigeon-making machine lies in the fact that the birds can be used indefinitely. After they are shot to pieces, the fragments are picked up, placed on a screen that sifts out the dirt, cleaned off, and then put back in the melting-pot and used over and over again. The birds show no sign of deterioration. Up to the fourth or fifth time they are fully as



After the birds are shot, the pieces are picked up, cleaned, remelted, and remade; in this way, the clay is used over and over again



The boy at the trap sets it at an angle and then hurls the pigeons into the air: sportsmen are waiting near by to shoot at them



He is making clay pigeons. How? By pouring hot liquid into molds, into which forms are lowered, forcing the liquid into shape; when hard the pigeons are taken out

Painting the clay pigeons. This operation is at present accomplished by hand: but Mr. Teeple is now working on a machine that will do this work in the near future

good as those cast from new composition. After that fresh materials must be added. Yet some of Mr. Teeple's pigeons are "killed" hundreds of times.

So successful has this machine proved that Mr. Teeple is now working on a new one. This is to have twenty-five links with three molds apiece, to which the liquid will be fed automatically from a large overhead tank. By this means a million birds will come to life each year.

What Will He Do with So Many?

What is Mr. Teeple going to do with all these birds, when at present he needs only one third as many? His idea is that thousands of young men who never held a gun until they joined the army will come back good shooters, anxious to keep their skill, and that many of these ex-soldiers will join his club.

Shooting live birds for sport has always been frowned on in the United States—particularly that branch of bird-shooting in which live birds are caught, trapped, and then released at a signal to be shot at.

Formerly pigeons were mainly used for this purpose. They were put in five traps stationed about five yards apart on the arc of a circle whose radius was about thirty yards. The shooter stood at the center of the circle. One of the trap doors opened, out came the pigeons, and the marksman fired. If the birds fell within a given radius they counted as points. Those falling outside did not count.

Such cold-blooded killing does not appeal to warm-blooded people, and so clay pigeons have been substituted for the live ones, and a spring trap for hurling them out takes the place of the boxes in which the pigeons were formerly kept. The first traps made simply hurled the clay disks in one direction, and in a very short time the shooter knew just where to aim. This took the joy out of shooting.

Popularity of Trap-Shooting

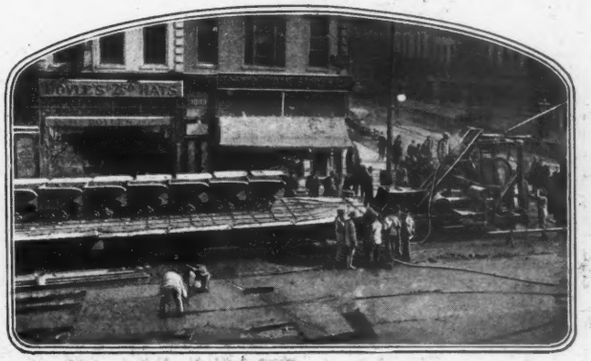
Traps are now made that hurl the birds in any direction and consequently resemble live birds in flight. The traps are located in sheds, and are out of sight of the shooters—sometimes the shooters stand behind the sheds. A boy in the shed aims the trap and shoots out his pigeons. He can aim them high or low, to right or left, in imitation of the flight of birds flushed from cover.

Those that the shooter hits break in pieces, but with no loss of life. A score is kept, and trap-shooting becomes an exciting game. The sport has grown until it comes second only to golf and tennis in the number of its followers.

Old Tracks Help Make New Ones

A HATTER in Denver wanted to sell his two-and-a-half dollar hats; the cigar store next door wanted to sell cigars; and all the other stores along the street were anxious to do business. But their sidewalks were piled high with the sand, stone, and cement which the street railway company was using for the foundation of its new tracks. The stores complained, and the company answered by mounting its materials and mixer on flat-cars that run on the old trolley tracks.

On the supply-car are three pairs of tracks which converge into one at the front end. Loaded dump-cars are lined up on two tracks; the third one is empty. A loaded dump-car is brought up front, emptied out into the mixer, and then sent back on the empty track. When the supply-car is empty it is taken back to the depot for more material, and another loaded supply-car takes its place.

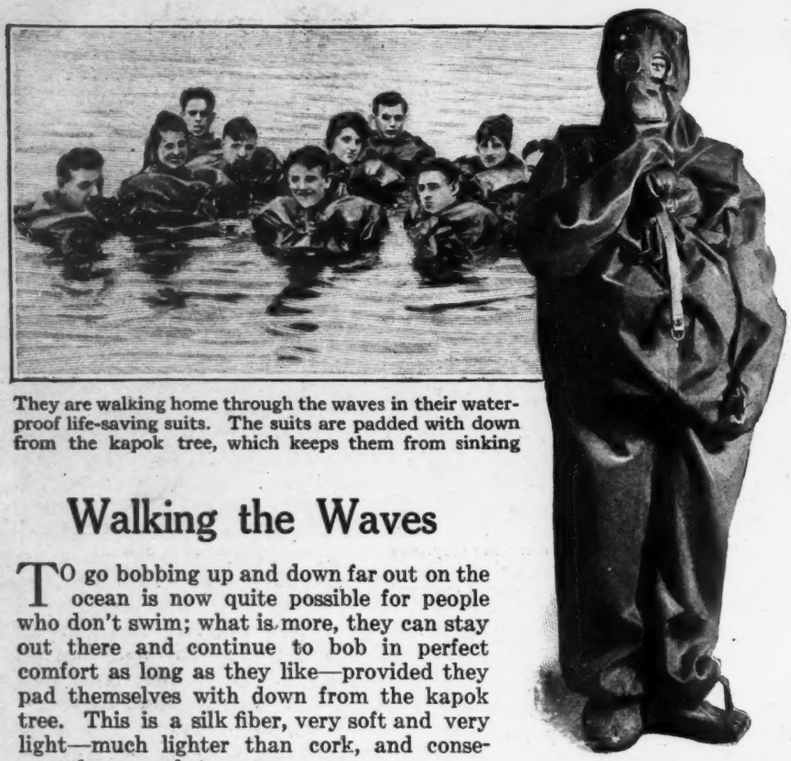


The material and the mixer needed for making the foundations of new trolley tracks are mounted on flat-cars that run on the old trolley tracks

Each dump-car holds thirteen cubic feet of sand, cement, and gravel mixed at the depot. When the load is emptied it falls into an elevating hopper which carries it to a mixing-drum. There it is mixed with water, coming out ready for use.

There are three supply-cars, working in relays: one is being loaded at the depot, while a second one is being dumped out at the job, and the third is on the way between the two.

The new method costs less than the old one, and so the company has benefited by its good deeds.



They are walking home through the waves in their waterproof life-saving suits. The suits are padded with down from the kapok tree, which keeps them from sinking

Walking the Waves

TO go bobbing up and down far out on the ocean is now quite possible for people who don't swim; what is more, they can stay out there and continue to bob in perfect comfort as long as they like—provided they pad themselves with down from the kapok tree. This is a silk fiber, very soft and very light—much lighter than cork, and consequently more buoyant.

Nine ounces of this substance will hold up the heaviest person; therefore kapok-lined, non-sinkable clothes are being made for the business of life-saving and the pleasure of bobbing. The suit, which is waterproof, looks like the combined outfit of a diver and a Ku Klux Klan chieftain. It is made in one piece from the neck down, including mitts and boots, and has an adjustable hood. The hood is usually worn over the face during business hours and down the back while bobbing.

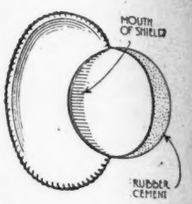
The kapok tree, which makes this suit possible, is found mainly in Java and Borneo. The light silk fibers grow in the seed-pods of the tree. They are too short to be spun into yarn, and have hitherto been used as filling for mattresses.

Inside this baggy, bogey suit is a girl. While she wears it she will never sink, for it is padded with kapok, which is lighter than cork

Ear Protection for Bathers

RUBBER ear-protectors for swimmers and shampoo victims have been invented by Frances Schurmeier, of Minnesota. They are made of one piece of rubber, generally oval-shaped, and having two V's cut in the middle of each side. A curved slit is cut in the center, and the two ends are folded over and sewed together. The ear enters by way of the curved slit, and the curved flap thus left is plastered to the cheek with a strip of rubber cement.

The secret of its success lies in the stitching. Long stitches would leave loopholes in the edge through which water might enter. We suggest careful overcasting.

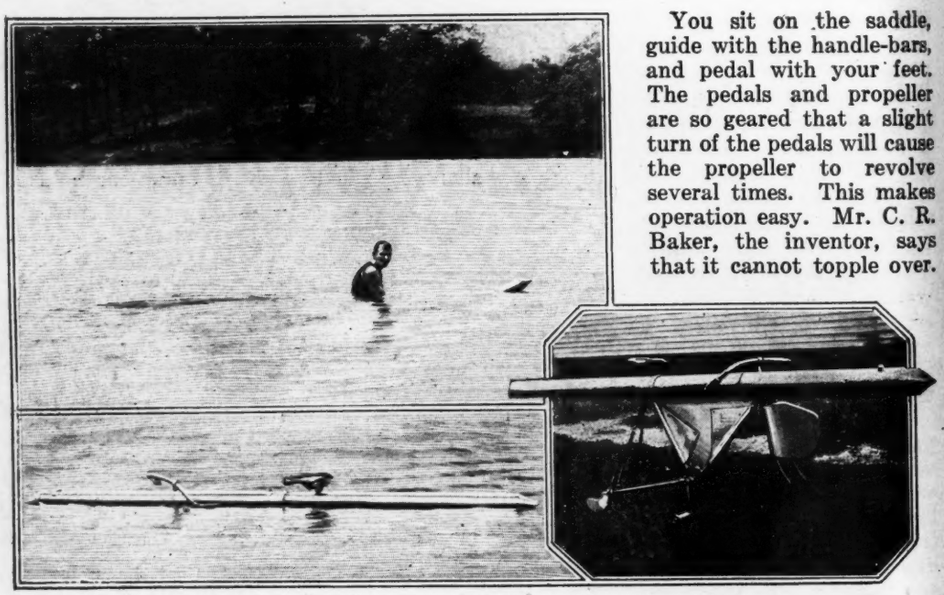


One-piece rubber earlaps will keep the water out of your ears

He Is Riding the Bicycle of the Sea

LOOK again. Surely that is a man sitting on the water and heading straight for your boat! Now you catch the glint of a metal point about a foot in front of him. One of those man-driven torpedoes you've heard about? But the war is over! He comes to within a few yards of you, then swerves off to the left and gradually disappears in the distance. How did he do it? Easily: he was riding a hydrocycle.

A hydrocycle is a sort of bicycle of the sea. It has the regular bicycle handle-bars, saddle, and pedals; but a rudder takes the place of the front wheel, and a propeller the back. The two torpedo-shaped tubes are water-tight and give the device buoyancy.



A hydrocycle is a water-bicycle; it has a rudder and a propeller instead of wheels, and water-tight tubes are attached to the cross-bar

You sit on the saddle, guide with the handle-bars, and pedal with your feet. The pedals and propeller are so geared that a slight turn of the pedals will cause the propeller to revolve several times. This makes operation easy. Mr. C. R. Baker, the inventor, says that it cannot topple over.

Can a Ship Swim Like a Fish?

What an inventor learned from sea creatures

COMING from a long line of whaler ancestors who handed down tales of the power and speed of the great sea mammals, James Worcester, of Waltham, Mass., often wondered why it was that if the screw propeller was the best means of speeding through the water the good Lord hadn't fitted out the whale with one. So Mr. Worcester began to study the movements of the tails of fishes and to work out a one-blade propeller of his own.

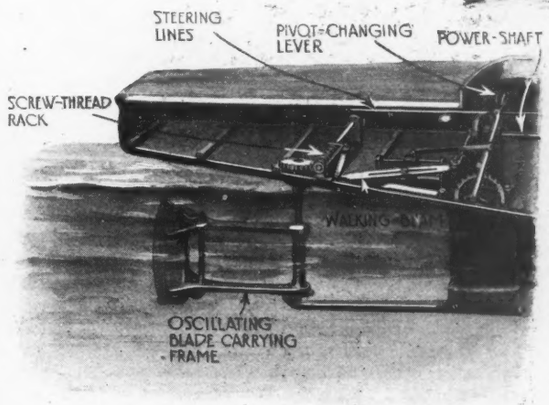
All the experts told him that rotary motions were better than reciprocating, and that, since his one-blade propeller was oscillatory and therefore belonged to the reciprocating class, it must fail in any contest with the screw. But Mr. Worcester kept on working; and now, when he is still an enthusiastic youth of sixty-eight, he has, he believes, solved all the problems.

He found he must have a blade playing between oscillating forks, which would give the blade the switching motion of the tip of a fish's tail, or the motion that the blade of an oar has in sculling. He also discovered that the best results were obtained when the angle between the forks was between ninety and one hundred degrees, and the maximum angle of oscillation of the blade, which the forks throw from side to side alternately, about ten degrees less.

With a model thirty-five inches long, propelled by a blade two and a quarter inches high by three quarters of an inch wide, and a clock-spring motor, he easily towed a twelve-foot canoe in which rode a twelve-year-old boy.

At another time, with a half-horsepower engine giving two hundred revolutions a minute, Mr. Worcester secured a speed of six miles an hour in an eighteen-foot boat that was equipped with a propeller blade ten inches long and three and a half inches wide.

An eighteen-inch model, propelled by a one-blade propeller, towed a twelve-foot canoe in which was a twelve-year-old boy



A detail of one of the forks that support the propeller blade and impart to the blade a wagging motion which sends the boat ahead

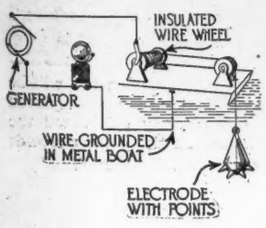
Mr. Worcester claims for his one-blade propeller that, with the same amount of power and at four hundred revolutions a minute, it will drive a boat four times as far as will the screw propeller; that the faster the propeller is driven the less will be the vibration; that with increased speed the boat does not draw down at the stern; that it will send a vessel backward as rapidly as ahead—the backing being done by swinging the propeller arms one hundred and eighty degrees; that, since the "one-blader" is steered by shifting the forked propelling arms and needs no rudder, she steers better than the common type; and that it is a non-fouling propeller.

In addition to all this, the inventor points out the ease with which the blades can be changed without going to the inconvenience of putting the ship in dry-dock.

Locating a Sunken Ship with Your Ears

SHOULD you see a man leaning over the side of a boat, obviously fishing with a telephone wire which hangs from a telephone head-piece he is wearing, be not alarmed. He is not a lunatic listening for the voice of a fish, but a credulous man who is trying out a new way of locating sunken ships.

At the end of the wire that hangs from the head-piece there is a spiked electrode which drags along the bottom. The other side of the telephone head-piece is connected to an electric generator, which in turn is attached by wire to the metal side of the vessel. Thus a high resistance circuit is established from the generator, through the telephone, down the wire, out of the electrode to the water, and then back through the vessel's metal side to the generaator.



When the electrode at the end of the wire hits a sunken boat, the resistance in the circuit will be greatly reduced and the man wearing the telephone head-piece will hear about it

When the spiked electrode hits a sunken boat the resistance will be greatly reduced—assuming, of course, that the body in contact is a conductor. This change will make itself apparent in the telephone, and the listener will stop and fish up his catch. If he is lucky it will be what he was looking for.

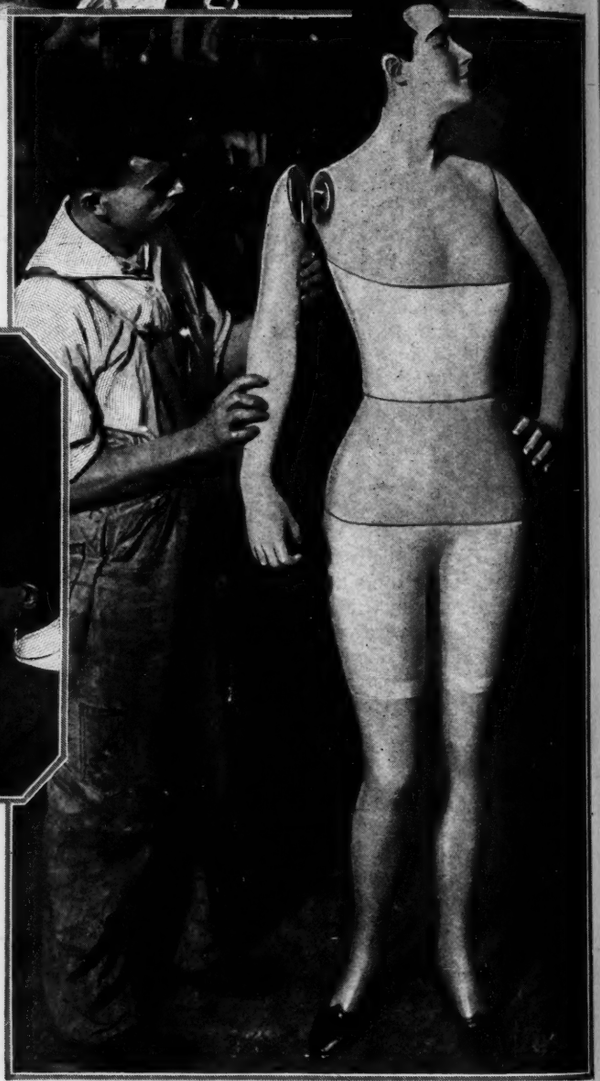
Patrick B. Delany, who lives in the State of New Jersey, is the father of this invention.

Those Beautiful Big Dolls in the Shop-Windows

Photographs © Publishers Photo Service

Giving them their first bath; they have just come out of the mold, and are put in the water so that they will cool and harden—hairless, toothless, helpless

At the hair-dresser's their bald heads are beautifully covered —not with wigs, but with separate hairs, each one pushed into place with a hot pointed instrument, so as to resemble closely growing hair



Comparing a wax arm with a flesh-and-blood one. The arms, head, and shoulders are made of wax, but the rest of the body is constructed of papier-mâché

The sculptor is working on a head from which a new mold will be made; by using a model he manages to give the head a life-like expression

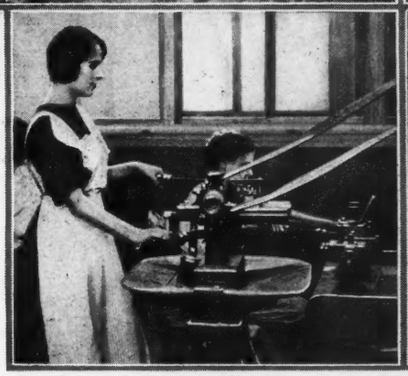
After her arm has been snapped into position she will be properly dressed in the very latest mode and placed in the shop-window. She has already cultivated the supercilious look which she will use on the gaping crowds

Where Your Amber Pipe-Stem Came From

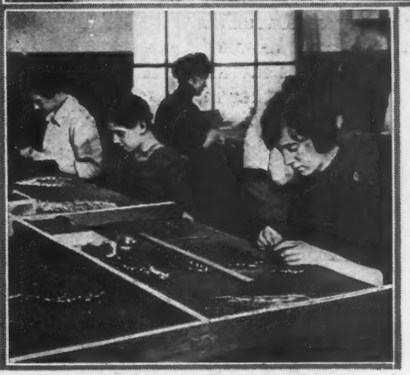
Amber is a beautiful yellow resin formed by extinct pine-trees

Most of it is mined from the famous "blue earth" of East Prussia

Electrically driven lathes for shaping amber. It is polished with whitening and water or with rotten-stone and oil, the final luster being given by friction with flannel. Much electricity is developed in the process



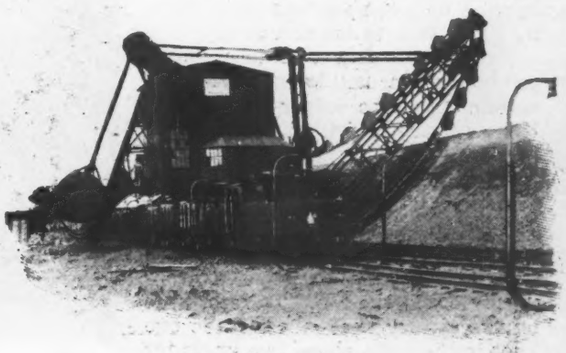
Women do much of the finer finishing work on articles made from amber. Here they are turning and polishing cigar-holders. Superstitious persons sometimes wear beads or carry pieces of amber to keep off contagious diseases



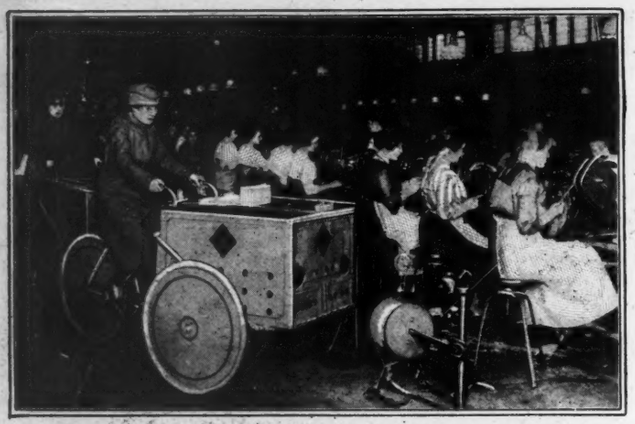
Stringing amber beads in a factory. Beads of amber are found with Anglo-Saxon relics in the south of England, and were formerly valued as amulets. At the present day India is the greatest market for beads of every color, form, and size

Even the refuse left when the amber has been worked is valuable. It is melted over a coke fire and made into amber lacquer. The skilled amber workers belong to the ancient Guild of Amber Artisans

Fishing with nets for amber in the Baltic after a storm has washed the precious fossil resin from the banks



Steam-shovels dig out the amber matrix and load it on cars which carry it to the factories



They are not despatch riders, though they wear military uniforms. They collect packages in the Westinghouse plant

One Place Where There Is Good Mail Service

"IF the first-class letters we send out daily were put end to end, they would reach over two miles," says the Westinghouse Electric and Manufacturing Company. Besides the first-class mail there is the second-class, third-class, and the inter-department mail.

How is this large amount of mail handled? The letters are sent down pneumatic chutes; the heavier mail is carried off in tricycles and trucks. The trucks, which run by means of storage batteries, collect the heaviest packages, while the tricycles gather in magazines, circulars, and blue-prints. Men steer the trucks, boys and girls the tricycles. It is estimated that they travel 14,295 miles a year.

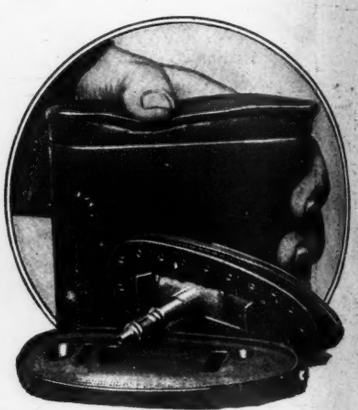
Taking the Kick Out of a Gun and the Jar from a Crutch

A SHOULDER pad has been invented by Paul Krueger, of Illinois, to fit under the shoulder on top of a crutch or over the shoulder on the end of a gun. It contains an air cushion which protects the shoulder from the recoil of a gun and from jars caused by the impact of a crutch with the sidewalk.

It is attached to the crutch in the following way: first the air cushion is blown up by either a bicycle pump or a very strong pair of lungs. It is then laced in between a leather cover and a metal base plate curved to fit the crutch top. A screw, attached to the plate, fits through a hole in the crutch, and is held fast by a nut.

To attach it to a gun's end, a metal plate is first screwed to the butt of the gun; then projections on the pad are fitted into holes in the plate and fastened in place by a set-screw at the side.

Screwed to the top of a crutch or the end of a gun



A metal plate is fastened to the butt of the gun, and the pad is fitted into holes in the plate and fastened into place by a set-screw. The pad protects the shoulder from the gun's recoil. It is even more useful on a crutch

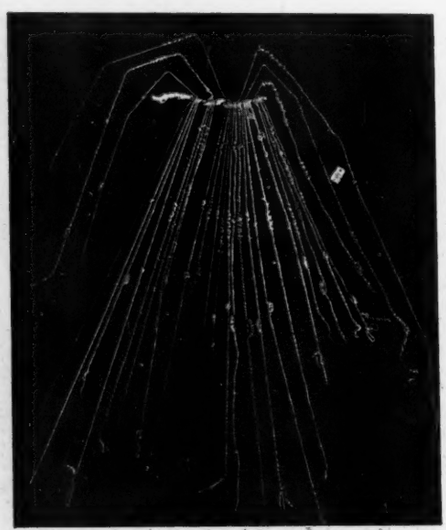
A Truly Knotty Problem

How bookkeeping was carried on by the ancient Peruvians

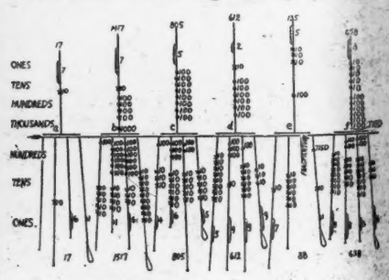
TODAY it is chiefly clergymen and sailors who tie knots during business hours; but centuries ago bookkeepers did it too. A Peruvian bookkeeper's ledger was a regular rope curtain with knots running up and down the ropes. He took to knots because he had no system of writing by which to keep his accounts.

Each rope represented an account; the bookkeeper had twenty-four rope accounts on one ledger—the ledger being a heavy rope from which all the accounts hung. In his mind's eye he divided each rope into three parts to represent the first three places of the decimal system. The units place was at the end of the rope; the tens place half way up; and the hundreds place close to the top. To record the number 1, the bookkeeper made one knot in the units place, two knots for number two, and so on. Likewise, one knot in the tens place represented ten, two knots twenty; one knot in the hundreds place one hundred, and two knots two hundred.

When it came time to balance, he combined his accounts in groups of four each, and added them on a fifth rope which came out of the top of the ledger. This fifth rope had a fourth division on it for the thousands place and so the bookkeeper was able to count and record figures up to 9,999.

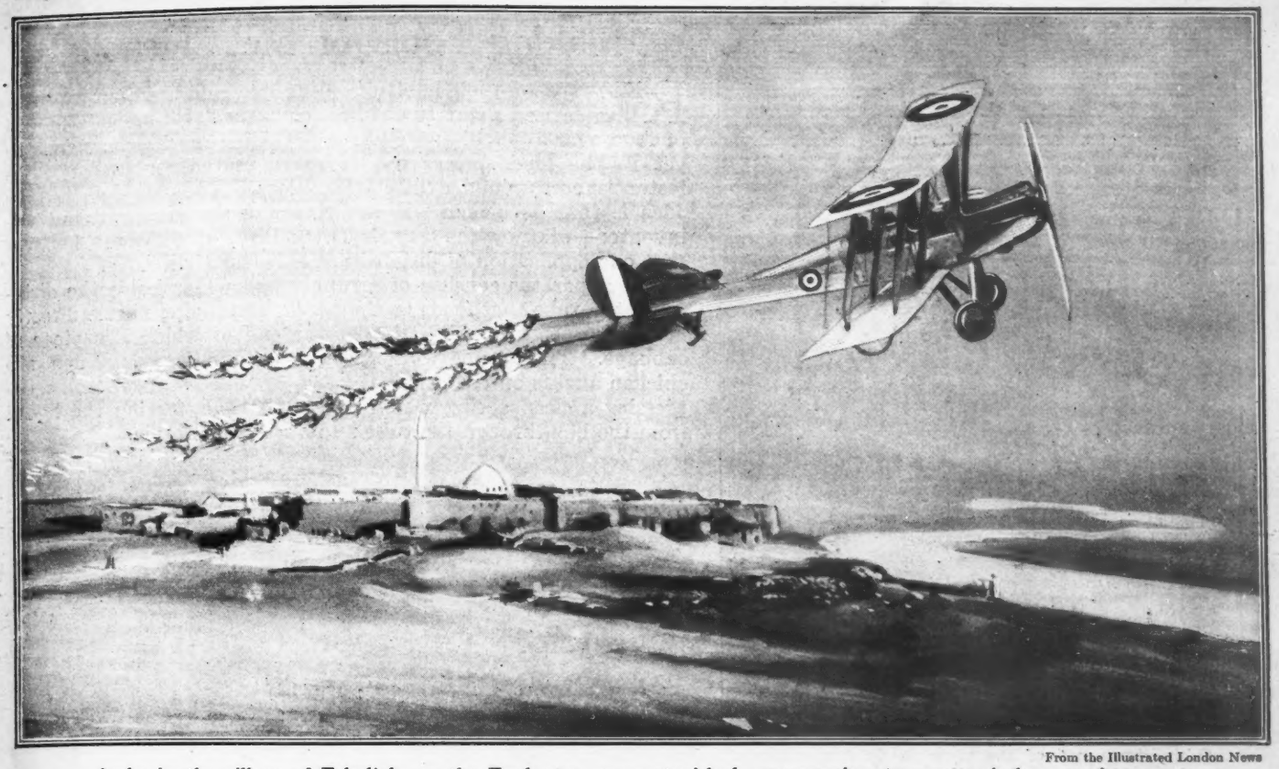


This centipede of cords is an ancient Peruvian ledger; the knots on the cords are made in sections to represent units, tens, and hundreds



In this simplified bookkeeping four accounts are grouped together and added, and the sum is recorded on a single cord above

Photographs by courtesy of American Museum of Natural History



From the Illustrated London News

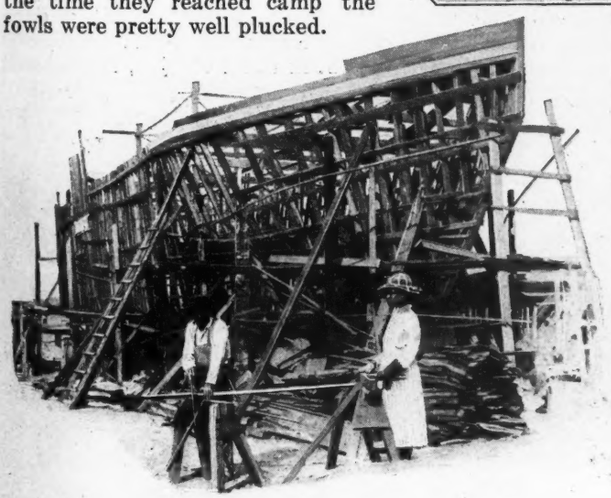
Arabs in the village of Feludjah, on the Euphrates, were astonished, one morning, to see an airplane passing overhead, apparently pursued by two long strings of birds; but it was only a British flier bringing fowls home from market

When Chickens Homeward Fly

TALK about the commercial possibilities of the airplane! While we in this country are waiting to have landing fields built, or are trying out airplane delivery as an advertising stunt, the inhabitants of ancient Hit, at the head of navigation on the Euphrates river, have had a spectacular demonstration.

British airmen who helped to conquer Mesopotamia, scouting out of Hit for supplies in peace time, found chickens in abundance in one of the outlying villages. They bought enough to keep their company happy for several meals, tied them in two long strings to the tail of the machine, and set sail. By the time they reached camp the fowls were pretty well plucked.

On Sunday Parson Lewis doesn't work on the missionary ship he is building, but preaches and teaches Sunday school lessons. He is the founder of a new religion which he calls the "Church of the Living God"



This ship—made so far of spliced, patched, and split scrap lumber—will take a band of missionaries to Liberia, if it doesn't sink

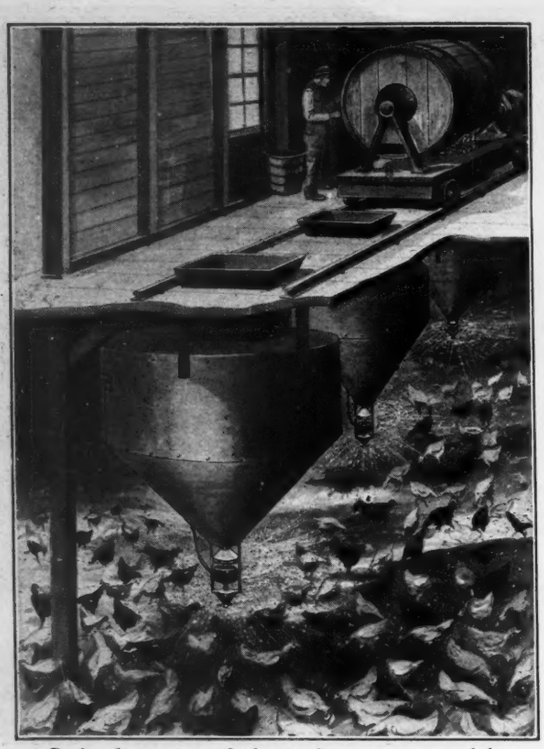
This Noah Is Building His Ark

"CHURCH of the Living God" is the name of a new religion started by the Rev. J. E. Lewis, a negro preacher living on Terminal Island, in Los Angeles harbor. At present he has fifteen followers, but he expects many more before long. For he is not only a preacher, but a shipbuilder, and he is now engaged in building a ship in which he intends to sail to Liberia, the land of his birth, and there convert his own people.

What kind of a ship is he building? Well, the framework is being constructed out of scrap lumber from an old house; for smokestacks he is using battered funnels taken from a wreck in the bay; and he is gathering most of his material in like fashion.

Mr. Lewis has been working on his ship for a year now, and he has already completed the hull frame, eighty-five feet long and thirty feet high. The ways are three short logs, and there are no keel-blocks at all. The cement ship walls, to be thirteen inches thick, will require one hundred and twenty-five tons of concrete. So far, five bags of cement have been donated. A gasoline engine and sails will drive the "yacht," and Parson Lewis will be its captain.

His shipyard is his back yard. In fact, his home—which is also his church and Sunday-school room—lies almost under the bow of the ship. Under its stern is a chicken-coop that will make the trip loaded with chickens.



Grain drops out of the tank on to a revolving paddle, which scatters it; and so the chickens are fed

One Way to Feed Poultry

A POULTRYMAN living in New Hampshire has fifteen hundred hens, and so has fifteen hundred mouths to feed several times a day. His major-domo is a clock—a time-clock, which starts a motor, this in turn causing six large tanks to scatter feed over 4,526 square feet of ground, thus allowing each hen three square feet of food.

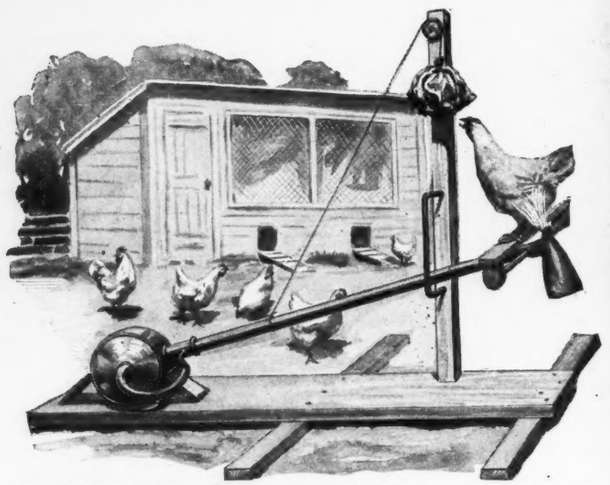
Each iron tank is attached to the ceiling of the hen-house and tapers down almost to the floor. There is a small door in the end of the tank which remains shut when the motor isn't working. But when the clock starts the motor, the motor revolves a short vertical shaft, which opens the door and drops some of its twenty-two bushels of feed on to a swiftly revolving paddle. This sends the feed in all directions.

The twenty-two bushels are fed to each tank from a mixing barrel on the floor above.

Making Fools of the Chickens

RELYING on their habit of eating now and then, an inventor has devised a way to disinfect chickens. He hangs a morsel of food near a perch, and when a chicken leaps to the perch to get it, the food springs out of reach and a stream of disinfectant shoots up under the chicken's legs. The only defect in the idea is that a chicken will not return a second time; but the inventor—who, by the way, is D. B. Bird, of Chicago—believes that one application of disinfectant is better than none.

The apparatus consists of a rubber ball which holds the disinfectant, a tube that leads to the perch, a spraying nozzle directly below the perch, and a string at the end of which is a piece of cabbage. The device works nearly automatically. When the chicken alights on the perch, the arm or tube is thrown down, depressing a clasp spring which covers the ball, forcing the liquid from the ball through the tube and out of the nozzle.



The chicken is fooled and disinfected before it has time to cackle

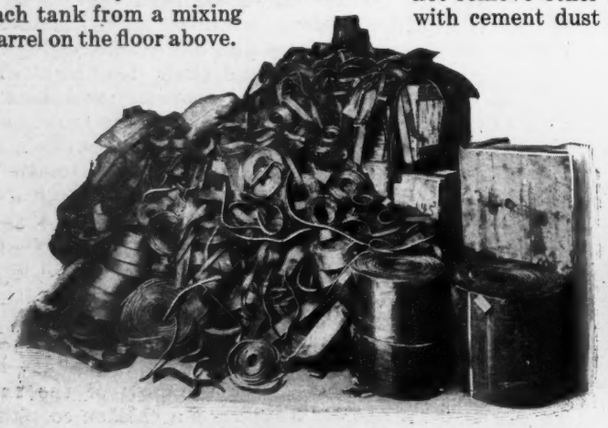
Sick Leather Made Well

A KIND of sanatorium for abused, burned, water-soaked, oil-soaked, dirty, or worn-out leather belting has been built at Grand Rapids, Mich. Much of the leather that would otherwise have been turned over to the junkman goes to this sanatorium and comes out in excellent shape.

All of these various ailments must be treated in different ways, so the chemists at work there found. A solvent that removes machine oils will not remove other stains; a belt filled with cement dust from a cement mill must receive treatment other than that given to a belt from a textile mill. Altogether, eight different solvents are used.

When a load of leather is brought in for renovation, it is thoroughly cleaned and then dried out; next it is relubricated with animal fats, and restretched. The belting is then sorted, graded, recemented, and rolled up, ready for use again.

Many a worn leather belt, after receiving treatment in this sanatorium, goes back to its old job, rejuvenated.



These tangled rolls of leather belting have suffered a complete breakdown after their years of hard service

But after they are cleaned, dried, relubricated, restretched, and recemented, they are nearly as good as new again

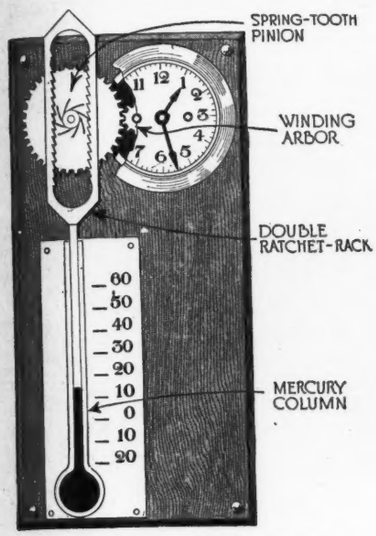
Let the Weather Wind Your Clock

WHEN the temperature rises twenty degrees in Aquila, Switzerland, Victor Guillani's clock gets a good winding. How so? Because Victor Guillani lives in Aquila, and his thermometer winds his clock.

A rod rests on the surface of the column of mercury in his thermometer, being connected at the other end to a saw-toothed rack. As the temperature rises, the mercury—expanding up the tube—pushes the rod and its saw-toothed rack before it.

The rack, which meshes with a series of small springs, thus turns the axis to which they are attached. On this axis there is also a large wheel, which in turn meshes with the wheelwork of the clock-spring, and consequently winds it. When the temperature goes down, the same rotating takes place; and between the two the clock is always wound with no trouble to the owner.

Why did Mr. Guillani go to all this trouble in order to wind his clock? Perhaps he caught the calories fever so prevalent in this country last year and decided not to waste any of them.



When the mercury rises, it pushes up a rod, which turns a gear that meshes with the wheelwork of a clock

The hanging fan is handy for the barber, and it also serves as advertising space

If your barber waved an advertisement in your face for several seconds, you would remember it and some day buy the product advertised

You Can't Miss Them

THE fans in the barber shop above are part of the advertising scheme of Edward E. Linehan, of St. Paul, Minn. While customers are getting hair-cuts, shaves, and shampoos, these fans, heavily laden with advertisements, will dangle in front of their eyes.

When the barber wishes to use the fan he reaches up and pulls it down. When he is through he releases it and it goes back. This is accomplished by a weight attached to the cord on which it hangs.

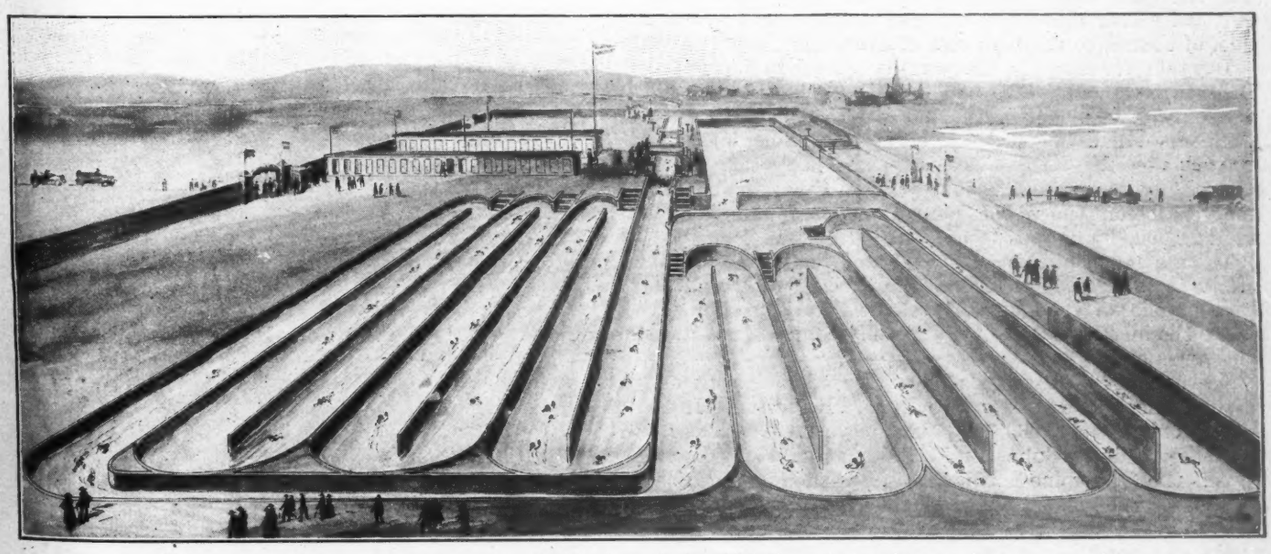
According to the inventor, everybody will benefit by his scheme—advertiser, barber, and the man in the chair.

Where the Tide Is Always with You

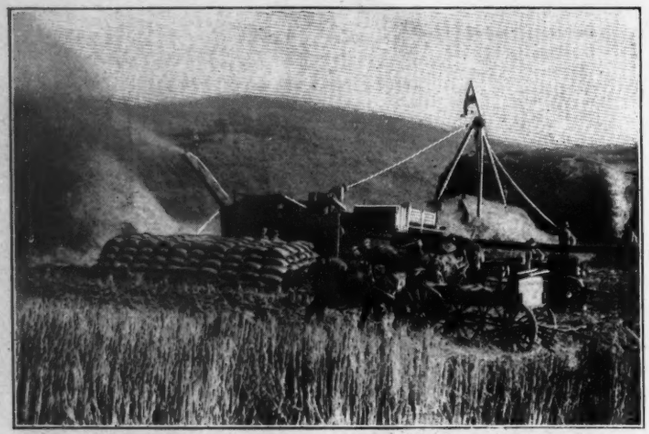
"DOWNSTREAM swimming is the most pleasing and exhilarating form of exercise," says Mr. John W. Lippincott; and he ought to know, for he is owner, manager, and instructor of a large swimming-pool at Little Rock, Ark. He has patented a pool in which the water runs forever downstream through long, narrow, parallel connecting channels. There are fourteen of them, each one about a block long and fifteen feet wide.

You jump off at the beginning of number one, which is in the center, and start swimming. The downward grade carries the water and you along to number two, and so on till you reach seven—if you last that long. If you don't you may climb out at one of the bends. You continue on to fourteen, which goes back to where you started from.

Suppose you want to go on? A pump will pump you and just enough water over the top. The remainder will pass off into an ordinary pool. As yet no one has built one of these pools.



This pool is made up of long, narrow connecting channels, in which the water carries you along as you swim

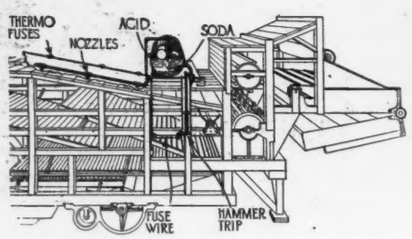


When the wheat dust thrown off by threshing-machines forms clouds and explodes, the automatic fire-extinguisher comes into action

Preventing Wheat-Dust Explosions

CAN wheat explode? It not only can, but does. Wheat explosions have caused loss of life and destruction of property. The difficulty is that clouds of dust are thrown out by the machines that thresh the wheat grain from the straw. The fine dust particles mingle with the air, often forming a mixture that is as easily ignited as is gasoline vapor.

The United States Department of Agriculture investigated this problem. Its experts now recommend automatic fire-extinguishers for the threshers. The extinguisher consists of a tank of water containing soda, in which a bottle of sulphuric acid is placed. In case of fire, one of the fuses distributed about the machine will be melted. The mechanism breaks the acid-bottle, and the ensuing chemical action gives off carbon dioxide through nozzles.



Fire will melt one of the fuses that are distributed about the threshing machine, and this will start the fire-extinguisher working

Food Center for the World

THE United States is now exporting four times the amount of foodstuffs that it exported before the war, and the money value is six times as great. Before the war the value was about $500,000,000; now it is $3,000,000,000. This difference between amount and value is due, of course, to the high cost of everything.

But take, for example, the quantity of fresh beef exported. In 1918 it amounted to 540,000,000 pounds; in 1914 it was only 6,300,000 pounds—one ninetieth as much. No wonder we had "meatless Tuesdays." At least 1,000,000,000 pounds of bacon was exported last year. Compare this with the 200,000,000 pounds exported in 1913, the year before the war began. Condensed milk jumped from 21,000,000 pounds to 553,000,000 pounds.

Though much of this food went to Europe to feed our armies in France and our Allies who were cut off from their food supplies, a good deal of it went to other countries, where the increased trade will probably continue now that the war is over.

Nearly 25,000,000 pounds of condensed milk sent out of the country in 1918 went to India. Before that India bought only about 7,000,000 pounds a year. We also sent condensed milk to Cuba, Straits Settlements, Hong-Kong, Japan, the Philippine Islands, and British South Africa.

Most of the refined sugar—25,000,000 pounds of it—went to Belgium; but Mexico, Newfoundland, and British Africa also got their share.

An Apron for You and Your Piano

A PIANO apron has been invented by Emil R. W. Civita, of Pittsburgh. And what is a piano apron? A large-sized bib having a keyboard painted across the bottom. And why was this creation brought forth? That you and your fellow men might learn to play the piano without looking at the keys.

You tie one end of the apron around your neck and the other end around the piano, so that the painted keyboard lies in its proper place above the real keyboard. You fumble beneath the apron to get your bearings, occasionally poking up at the painted notes to make sure, and then start to play.

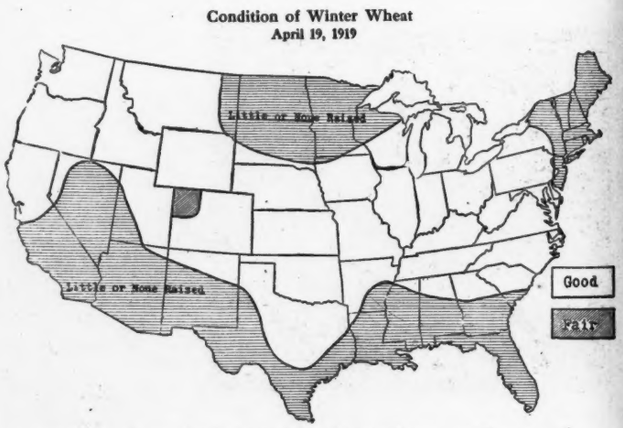
You look fixedly at your music, but the big black cloth keys so near, which stare you in the face, are supposed to help guide your wandering hands. An expert psychologist might be able to tell you whether this is true or not.

This piano apron, with its painted keyboard, will permit your hands to become acquainted with the real keyboard while your eyes look fixedly at your music

Where the Wheat Comes From

FEEDING Europe necessitates growing more food—particularly wheat. Have we done it? Most assuredly. The winter wheat crop, for instance, is estimated at nine hundred million bushels, a crop one third again as much as the record-breaking one of 1914. Many Southern States grew winter wheat last season for the first time. Of course, the favorable weather and absence of wheat-killing bugs helped make the record. The map shows the vast area in which it was grown. Possibly the government guaranty of price is responsible for some of the acreage.

Canada has also increased her winter wheat crop greatly. In fact, it is probable that the two countries together will produce forty per cent of the world's wheat crop this year.



Except for a few States along the northern, southern, and eastern borders, wheat is grown all over the United States

The Rice that Put the Starch in Beer

What shall we do with these broken grains now?

By S. R. Winters

THAT brewers in this country have been using millions of bushels of barley and corn annually is common knowledge; but few Americans know that the beer-vats of the United States consumed yearly approximately 143,285,580 pounds of broken rice, which is equal to three times the combined amount of barley and corn consumed. The demands of the brewing industry of America have hitherto exceeded the home-grown supply, and something like 37,730,024 pounds of brewers' rice have been imported annually from foreign countries.

Note the classification—brewers' rice! This is made up of the tiniest particles of milled rice,—broken pieces of less than one third of a grain in size,—and it is called brewers' rice because it is consumed entirely by beer-vats throughout the country. Rice "screenings"—broken rice in particles that are slightly larger than brewers' rice—are also eagerly bought by the brewers.

Heretofore the brewing industry has purchased about ten pounds of every 162-pound barrel of the rice growing in Louisiana, Texas, Arkansas, and the Carolinas. The 1918 crop is 38,000,000 bushels—computed in terms of rough rice. Ordinarily some 2,345,679 bushels of this would be converted into starch as a source of alcoholic strength to beer.

What to Do with It?

But with soft-drink establishments supplanting expensive beer-manufacturing plants, and with some distilleries being transformed into canneries, what outlet has the accumulating brewers' rice? This question was propounded of F. B. Wise, the rice expert of the United States Department of Agriculture, and elicited many suggestions.

Rice flour will make good bread if it is mixed with some other flour; but a loaf made from rice flour alone will be much smaller than a loaf made from an equal quantity of wheat flour

The Food Administration has consented to include in its cargoes of foodstuffs to starving Europe a quantity of the brewers' rice and screenings that are now stored in the rice warehouses of the South. Scarcely six pounds of rice a year is consumed by each person in America; whereas the per capita consumption in foreign countries is as follows: in Japan each man, woman, and child consumes 147 pounds of rice a year; in China, 158 pounds; in Russia, 11 pounds; in England, 27 pounds; in France, 34 pounds; in Italy, 101 pounds, and in Germany, something above 93 pounds.

"Rice flour made from broken or brewers' rice has been successfully used in the past year as a part substitute for wheat flour in baking," says Mr. Wise, whose knowledge of the cereal extends through the process of production and distribution to consumption. "The white color which the rice flour gave to the bread made this product much sought after by the baker." Here is the Department of Agriculture's recipe for rice-wheat bread:

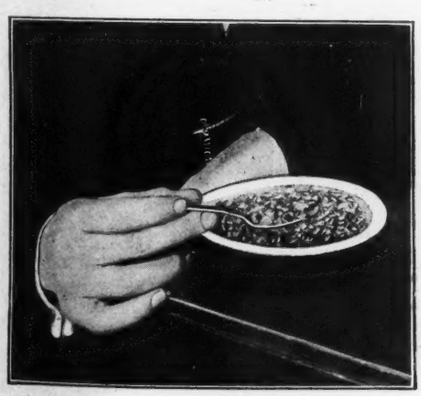
"One cup cooked rice, one-half cup flour, one cup milk, three fourths teaspoon salt, one tablespoon butter, one egg, and one half teaspoon baking powder. Mix the rice, butter, salt, and well beaten yolk of egg. Add the flour and milk. Mix thoroughly, and fold in the well beaten white of egg. Pour into a greased baking-dish and bake one half hour in a moderate oven."

Rice flour as an exclusive product in the making of bread is not only too expensive, — about twelve cents a pound,—but is devoid of gluten, contains only a small per cent of protein, and because of its brittle qualities will not hold together. Consequently, the future of rice flour is not so promising, although there are rice-mills in Tennessee, Texas, Louisiana, and California. The finished product is practically all starch—which made it valuable to the brewers.

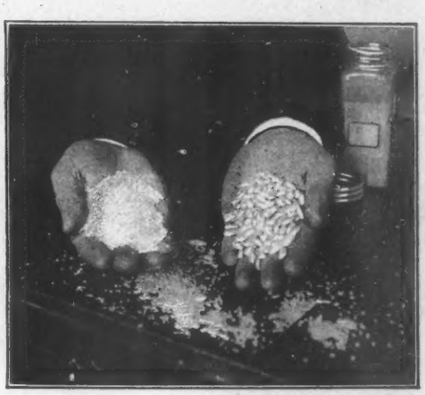
Uses for Brewers' Rice

Other uses devised by the ingenuity of science and economics for brewers' rice are these: a breakfast food similar to corn puffs, made from rice instead of corn and other cereals; dextrinized rice flour, a product similar to dextrinized corn flour, brands of which are already on the market; a tapioca-like product, similar to the so-called corn tapioca and somewhat like potato tapioca, which is manufactured extensively in France from potato starch; rice malt extract, made from a combination of rice and malt. The product would prove useful in baking and in the manufacture of confectionery and soft drinks.

"Besides these foods," says an eminent chemist, "broken or brewers' rice can be employed for the manufacture of starch. While rice could also be used in making alcohol, or used as a feed, I believe that this product is really too valuable to be thus degraded."



If you eat corn flakes then surely you will eat rice flakes, which look and taste very much like the other; the rice flakes will be made from brewers' rice

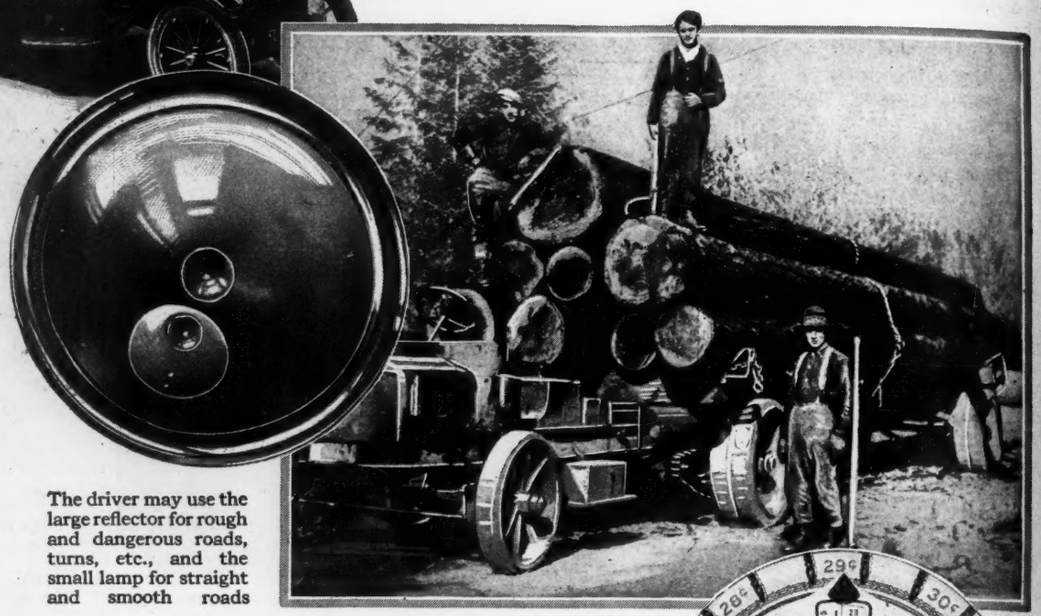


Besides being flaked, brewers' rice can be puffed, even though the rice is broken; and puffed rice is a nutritious and quite popular breakfast food

Speed Up Production by Using

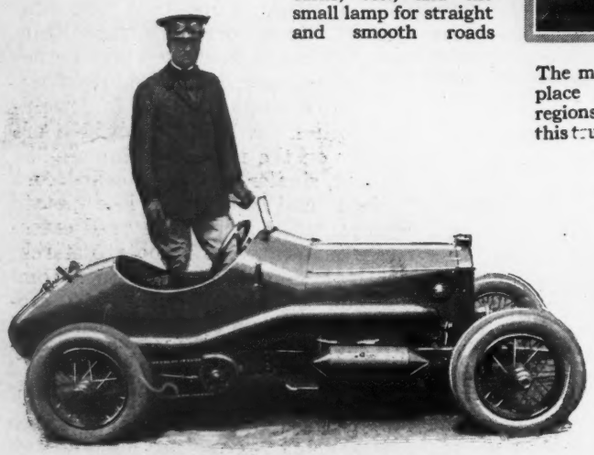
The adaptable automobile is

A Dallas, Texas, merchant takes his entire grocery stock to the customer's door and allows her to do her own choosing. The driver does not have to leave the wheel

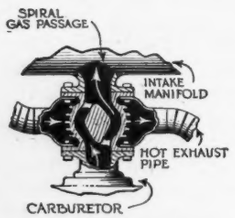


The driver may use the large reflector for rough and dangerous roads, turns, etc., and the small lamp for straight and smooth roads

The motor-truck is now taking the place of horses in the logging regions. It is not uncommon for this truck to carry thirty loads a day

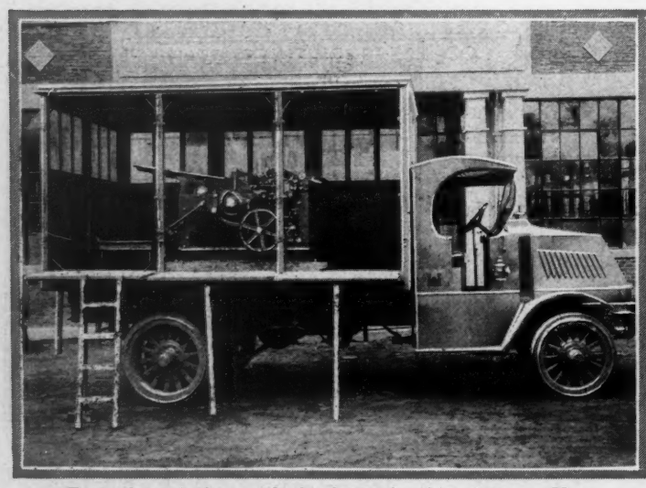


With all the equipment of its big racing brother, this miniature racing car was constructed from airplane parts

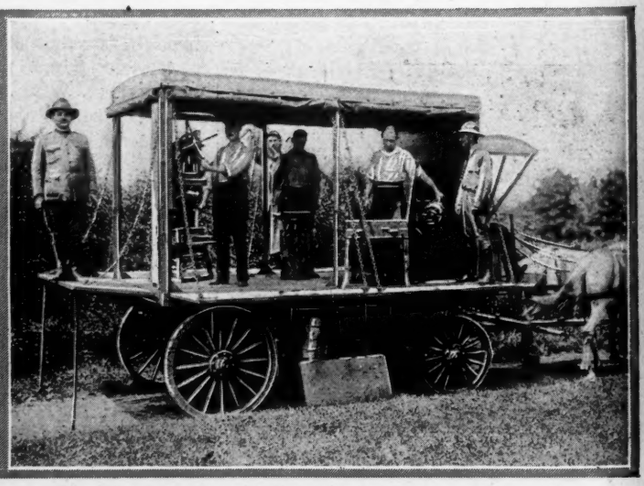


This device, installed between the carburetor and the intake manifold, converts the gasoline into a high-test gas before it reaches the cylinders

To figure the cost of from one to twenty gallons of gasoline, move the price to the top; then read the total cost on the figures showing through



Part of a printing outfit is shown in this picture. Not only was very fine work done with this equipment in France, but the operators worked in real comfort

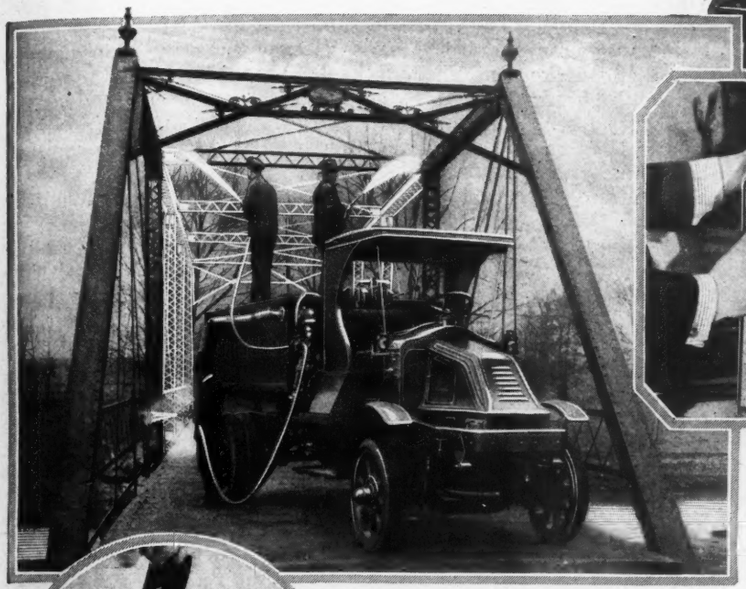


Here is a complete blacksmithing shop on wheels, either horse-drawn or for motor-truck. Watch for the traveling repairman who will mend machinery in the field

Up-to-date Motor Equipment

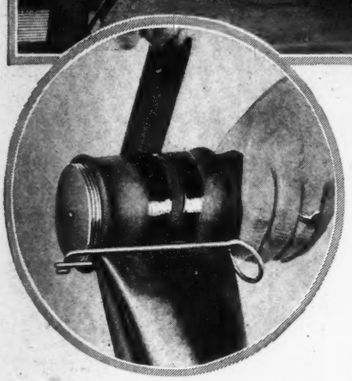
gradually displacing man hire

To tour across the country in one's own palace car is something that appeals to most people- This gentleman does it, traveling with all the conveniences of a Pullman

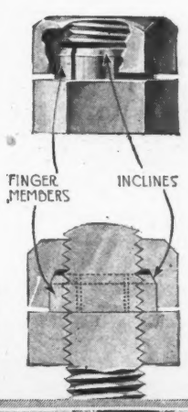


An emergency metal tank, made to fit into the front door of the Ford car, enables the owner to carry one reserve gallon of gasoline, oil, or water

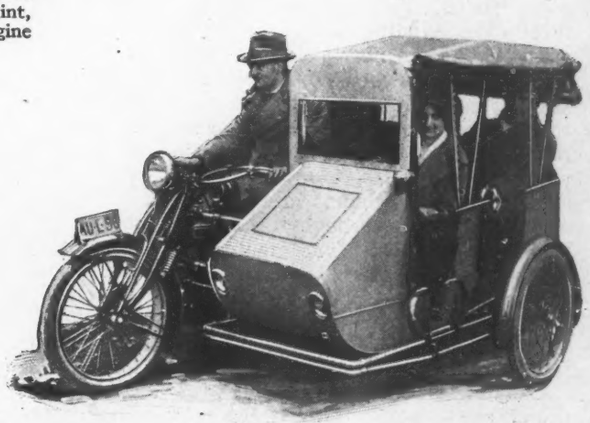
One of the almost myriad uses of the motor-truck is this new method of spraying bridges with cold-water paint, pumped by the truck's own engine



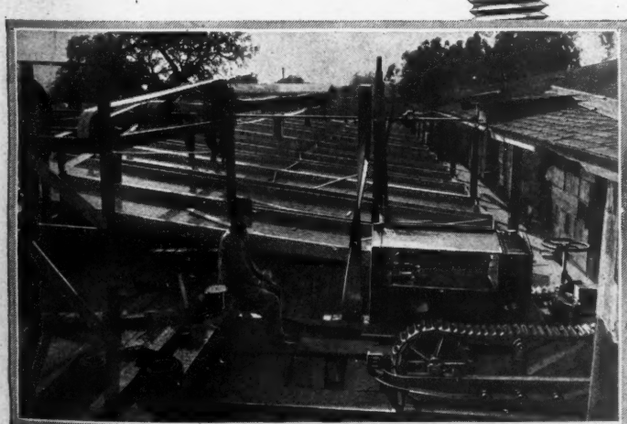
Place the punctured tube around the container, pull it down snugly, attach the clamp, then apply the patch over the hole, and an efficient and lasting repair will be made



Screwing down the upper nut forces the finger members of the lower nut into the thread, freezing both nuts to the bolt. It will not shake loose



Now comes the motorcycle taxicab. Two passengers can ride in it with comfort. It is wind- and weather-proof



The tractor operates the grading, washing, and drying plant of this orange ranch. After the orange season it goes back to its regular work of cultivating the grove

The automatic coupler attaches your car to any truck conveyance. The illustration shows how one man took his cattle to market. This device suggests a variety of uses

Doubling Niagara's Leap

How Canada plans to mine an inexhaustible supply of white coal

By P. Schwarzbach

NIAGARA FALLS—what do they signify? A gorgeous spectacle that every American should see once in his lifetime—preferably on his honeymoon? No; they represent also a source of vast electric power, the importance of which is readily seen when you realize that coal—our chief source of power—is being rapidly consumed, while no new coal is forming. At some not easily determined date the supply will give out! And Niagara will probably be turned into one enormous power plant. At the present time, while the need is not so great, Niagara Falls are divided between work and beauty—beauty coming first. To insure this, the amount of water that may be diverted from the falls for power purposes, by either Canada or the United States, has been limited.

How does water furnish power for generating electricity? Just as it used to furnish power for the miller. The water, flowing downhill, turned a water-wheel, which imparted its motion to the grinding machinery. The water-wheels are now called turbines, and they impart their motion to large alternators, which generate the electricity. The amount of electricity generated depends on the speed at which the turbine rotates, and that speed depends on the amount and velocity of water passing through it, and the height of the falls. The greater the distance—called "head"—the greater the power.

Canada Has No Coal

Canada is getting the greatest power she can out of her share of Niagara waters; for Canada has never discovered any vast coal-fields in her own country, and has had to import most of her coal. And so the greater the water-power she can produce, the less coal she need buy.

The great power canal shown on the opposite page is planned to run from the Welland river to a point on the Niagara river between Whirlpool and Queenston. At this point a power-house will be built which will generate enough electricity to supply most of the towns in the province of Ontario. The water of the Niagara river will enter the Welland river, which is now being widened and deepened, pass through the canal to its end, then drop suddenly through the air a distance of over three hundred feet, and immediately rush through the immense turbines of the power plant.

This big drop is the chief power factor of the canal. It is twice as great as the drop of Niagara Falls. Where does this additional 150-foot drop come from? Between the foot of Niagara Falls and Lake Ontario there is another fall—a gradual one of one hundred and fifty feet. The new canal starts above Niagara and ends at a point where the Niagara river is level with Lake Ontario, thus taking in the double falls.

This canal is being built by the Hydro-Electric Power Commission of Ontario. It will be eight and a half miles long and is to cost approximately $25,000,000. It will divert a flow of ten thousand cubic feet of water per second from the Niagara river, and this will result in generating three hundred thousand horsepower a second.

Widening the Welland River

This project means the excavation of fifteen million cubic yards of rock and earth. In other words, it entails enough digging to build a trench three feet wide and three feet deep across the widest part of the Russian Empire!

All this digging necessitates power; and Canada, we repeat, has no coal. So she is using her water-power to generate electricity, and is running her huge locomotives, shovels, drills, and practically all the necessary machinery by it.

In fixing up the Welland river to suit, it must be widened to forty feet, deepened to thirty feet, and the direction of its course must be reversed so that the diverted waters of the Niagara river will flow smoothly *up* the old Welland river into the canal. The work of deepening the river is now going on. A cable with a span of eight hundred feet has been stretched across the river, supported at either end by movable wooden towers. A clam-shell bucket hung from the cable is lowered into the water, whereupon it clutches three cubic yards of undesired river-bed, carries it back to the shore, dumps it in dump-cars, and goes back for more. The bucket is worked by electricity.

The digging of the canal itself has likewise been started. The first eight thousand feet of the canal, from the point where it leaves the Welland river, is dirt. The remainder is rock, except for a section near Whirlpool, which is dirt for about two thousand feet. The earth sections of the canal will have sloping sides—the bottom being thirty-four feet wide and the top one hundred and sixty-two feet wide. The average depth of water will be twenty-six feet. The rock sections will have vertical sides forty-eight feet wide and thirty-five feet deep.

The electric shovels used in digging up the dirt are the largest in the world. They pick up eight cubic yards of dirt, carry it to a dump-car eighty feet above, and go back for another load, all in less than a minute. Each shovel weighs three hundred and seventy-five tons.

The rock, of course, must first be broken up. This is done both by channelers and by blasting. The channelers used are the most powerful made. They have two eight-inch chopping engines, which strike alternately and cut to a depth of twenty feet. They are operated by compressed air at a pressure of about one hundred pounds per square inch.

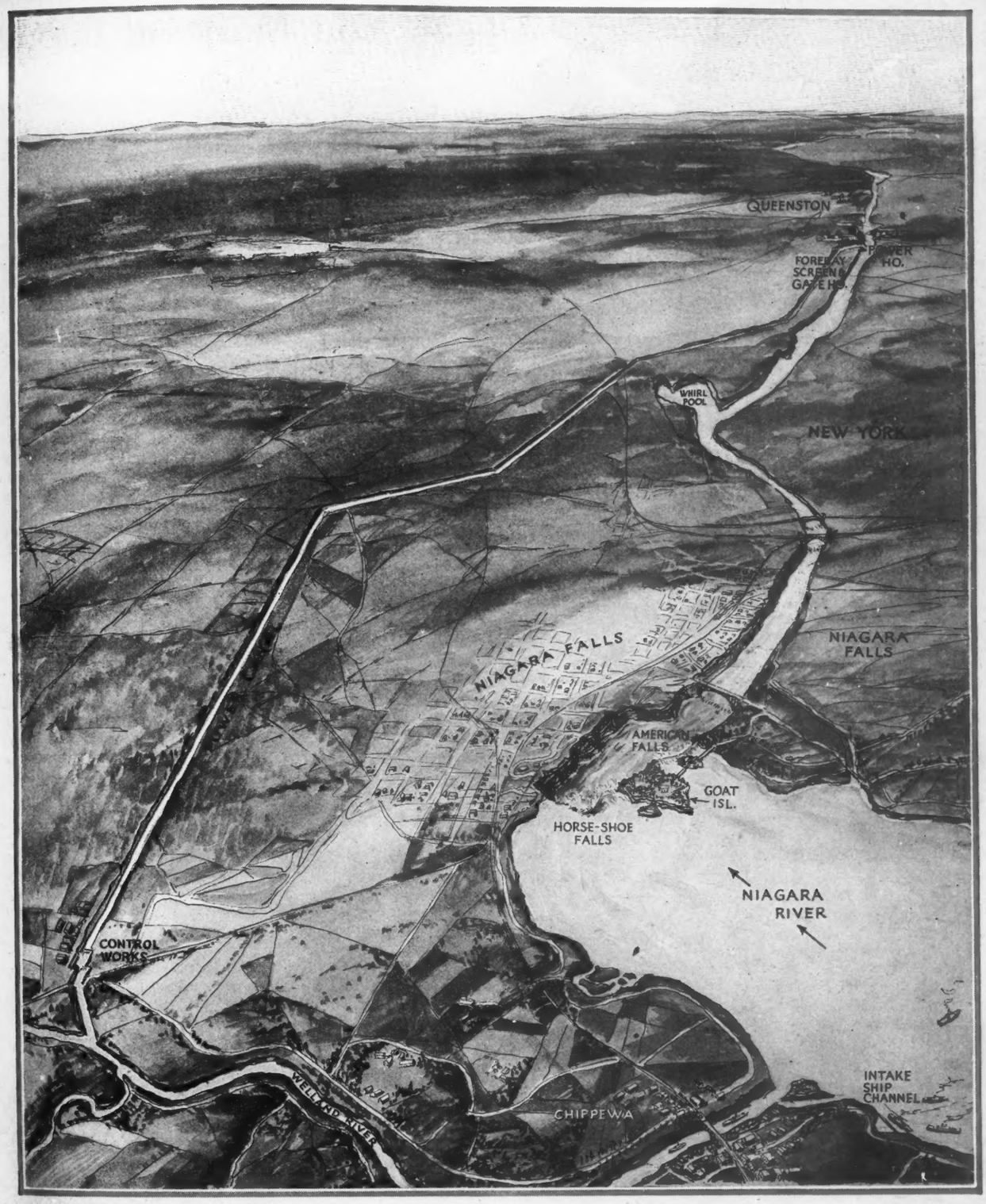
For drilling, hollow piston drills are used. The advantage of the hollow steel is that at each stroke of the piston the cuttings are blown out of the hole as rapidly as they are made. Thus none of the force of the blow is absorbed in grinding up the cuttings. Each hole is about twelve feet deep and the holes are placed about seven feet apart. In one blasting operation more than a thousand holes were shot at the same time. The result was that fifty thousand tons of rock were broken up. The great electric shovels then carried it away.

Rocks Turned into Concrete

All along the edge of the canal there is an electric construction railway which branches off to a main disposal dump. Overhead wires supply current to the locomotives. The dirt and rocks are carried off to the dump by the railway, and then most of the rocks are crushed for use as aggregate for concrete. Why make concrete? Because the digging of the canal necessitates the building of bridges to support the railroad tracks which now cross over places where the canal will be. Then, too, there will have to be extensive reinforced concrete intake structures at the point where the Niagara river turns into the Welland river.

The many machines for digging, dumping, and carting, and the fifteen hundred men who are doing the work, have made necessary the erection of many buildings: first, houses for the men; then, stations for supplying power to the railways, shovels, and construction plants. There is also a repair-shop, freight-houses, offices, store-houses, and a dressing-station with a doctor and nurse in attendance.

It is hoped that the canal will be finished by 1921.



Artificial Falls that Are Twice as Great as Niagara

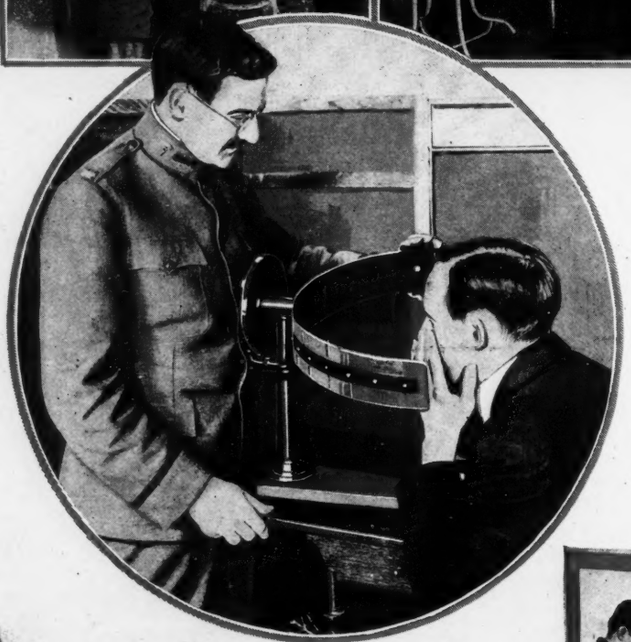
One of the greatest engineering feats in history is now being carried out by Canada. She needs at least three hundred thousand horsepower a second in order to supply coalless Ontario with light, heat, and power, and in order to get it she is widening the Welland river and forcing it to flow the wrong way; building a great canal from the river to a point near Queenston; erecting at that point a great power-house through which ten thousand cubic feet of water will rush every second. Just before this water reaches the power-house it will drop through the air a distance of three hundred feet. The immense quantity and the speed at which it comes will easily generate the three hundred thousand horsepower per second required. The artificial 300-foot fall combines the 150-foot fall of Niagara and another gradual fall of one hundred and fifty feet from the foot of Niagara Falls to Queenston

Tests You Must Go through

"Probably eighty per cent of the sick calls on the other side are made up of sore throats," says the report of the Air Service Medical. That's why this aviation candidate is being examined so thoroughly for adenoids and diseased tonsils

The aviator must be a good judge of distance. If he isn't he will not be able to tell the arrangement of an enemy formation or land safely at high speed. Here he is being tested for stereoscopic vision. If he has it he is probably a good judge of distance

When one eye is shaded from the light and the other is covered and uncovered rapidly, the pupil of the eye that is shaded will dilate and then contract about as the uncovered eye does — that is, it will if the eyes have normal connection between the fibers of the two optic nerves



Testing the psychological effects on the aviator of lack of oxygen, to determine how efficient he will be when he is flying at high altitudes

How much can you see without turning your head? To determine this, the aviation candidate is asked to fix his uncovered eye on the white spot in the center of the perimeter, as the machine is called, and, without removing his gaze from this spot, to indicate when he sees another spot move into the field of vision

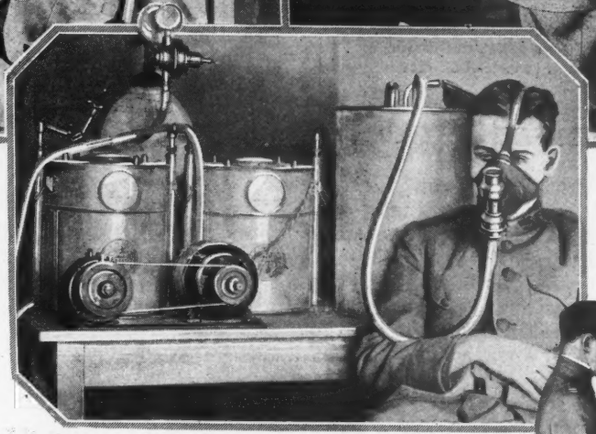
Of one hundred fliers only sixty-one can work at an altitude of more than 20,000 feet. The rebreathing machine determines precisely the altitude at which the flier will fail

if You Would Fly for Your Country

While the flying man may not be supposed to be much on his feet, he needs good ones, and the examination for flat foot and fallen arches is a very thorough one

The aviator must have good ear-motion sense. When he is shrouded in cloud it tells him whether or not he is flying on an even keel. This sense depends on a fluid in the canals of the inner ear. One test is to douche the ear with cold water and then have the subject attempt to point (with eyes closed) at where he last saw the examiner's finger

Testing the muscle balance of the eye. If the eye has a tendency to turn up or down, in or out, the aviator may see double, thus endangering his life at a critical moment



Another test of the aviator's ability to accommodate himself to the diminishing supply of oxygen at high altitudes. With this machine the amount of oxygen in the air breathed can be accurately controlled

After the examining surgeon has found the ears of the applicant free from apparent disease, he places him twenty feet away with his back turned, and tests the ability of each ear to hear whispered numbers and words

After touching the examiner's finger the applicant raises his arm in the air and with eyes closed is whirled rapidly about. When he comes to rest, he tries, with eyes still closed, to touch fingers with the examiner

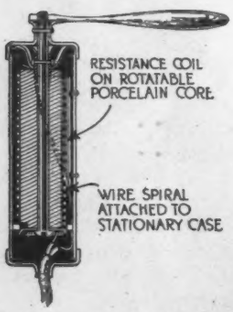
With eyes closed, the applicant is whirled to the left five times in ten seconds. If he is normal he will, when the chair comes to a stop, feel that he is falling to the right, and in trying to overcome it he will actually fall to the left

Designed chiefly for work in cramped quarters, this truck can be adapted to a great multitude of purposes. It turns in a twelve-foot circle

It Works in Limited Space

A CHICAGO company has just brought out an industrial truck driven by a conventional gasoline engine and other power-transmitting parts. Heretofore these small trucks have usually been electrically driven.

The new vehicle has three wheels—two in front and one in the rear. The latter serves to steer the vehicle, while the front two drive it. The radiator is located at the rear end. The engine is located just ahead of the radiator, and drives by means of a motor-truck type of clutch, gear-set, and internal gear-driven axle.



The resistance wire is wound on a porcelain cylinder which is mounted on the center shaft and keyed to it by a square collar

Doing It All with One Hand

OPERATING on the rheostatic principle, the head-light controller illustrated is so mounted that the automobilist can drive and control his lights with one hand.

As shown in the cross-sectional view, the resistance wire is wound on a porcelain cylinder mounted eccentrically on the center shaft and keyed to it by a square collar. The cylinder is supported and the shaft centered at the lower end by a flanged bearing plate pulled upward against a fixed collar by springs attached to the top of the cylinder. This assures smooth adjustment. The controller is so arranged that at no time will the circuit be open.

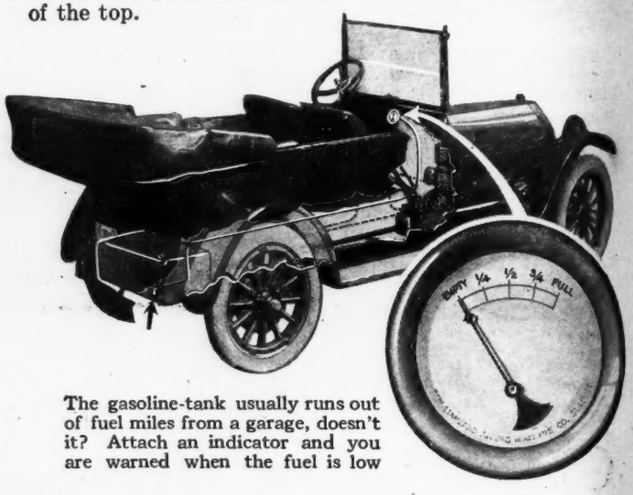
How's the Gasoline?

A NEW design of hydrostatic pressure-gage for indicating the amount of gasoline in the tank of an automobile has recently been perfected by a St. Louis manufacturer.

It is extremely simple in operation, having no moving parts to get out of order. It consists of two parts, a compensating air cylinder screwed into the bottom drain-plug opening of the gasoline-tank and a gage mounted in full view of the driver on the dashboard. The two members are connected by small-diameter copper tubing.

The gage is provided with a pointer, operated by a diaphragm inside, to indicate whether the tank is full, three quarters, one half, one quarter, or entirely empty. This diaphragm is moved backward and forward by the pressure of the air in the compensating cylinder attached beneath the gasoline-tank. The weight of the gasoline in the tank creates a certain pressure on the air in the cylinder, and this pressure is directly proportional to the amount of gasoline in the tank, so that the more gasoline the more the pressure and the more the gage-pointer is moved away from the empty end of the reading scale.

The gasoline, in running out of the bottom of the tank, is made to siphon back and press against the air in the compensating cylinder from the bottom instead of the top.

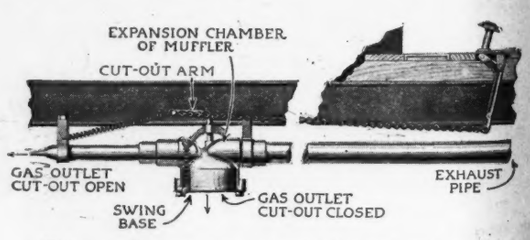


The gasoline-tank usually runs out of fuel miles from a garage, doesn't it? Attach an indicator and you are warned when the fuel is low

Muffler and Cut-Out Combined

ONE of the newest accessories for Fords consists of a combined muffler and cut-out, the latter being operated by a pedal placed in the floor-boards.

The apparatus is made of a casting with a flat bottom cover which is opened to give the exhaust gas cut-out. When the cover is closed, the gas passes through the expansion-chamber in the casting and then out through a rear pipe. The use of a casting for the muffler eliminates much of the rattle and noise of the usual type muffler as soon as the inside baffle-plates become loose in the shell due to vibration.



This muffler cut-out is much lighter and more compact than ordinary ones and it does not rattle

It's a Shock-Shifter Hub

IN Great Britain a shock-shifter wheel hub is being used to save road wear. The principle of the device is to interpose between the wheel-hub proper and the body of the wheel an annular chamber containing a number of steel balls which do not entirely fill it. The wheel is thus free to move a certain distance in a vertical plane. This distance is limited by a number of equally spaced bolts which are fitted in slightly larger-sized holes in the flanges of the hub.

These bolts constitute what is practically a liquid medium, the motion of which is affected by the movement of the wheel due to road shocks, the moving column of balls playing the part of an energy-absorber.

When the vehicle is stationary on the road, the hub rests upon the balls at the bottom of the retaining annular chamber, so that the axle and wheel are eccentric with each other. When the vehicle is in motion, the action of centrifugal force tends to distribute the balls symmetrically around the annular space. Their symmetry is somewhat upset, however, when the wheel is given an upward movement due to a road shock, and it is this change of motion of the steel balls which absorbs at least some of the road shocks.

When the car is in motion the balls play the part of an energy-absorber. This invention was designed to eliminate pneumatic tires

In a test of the hub (which is the invention of a Mr. Muir) on a taxicab, it is said that the ease of riding was favorable when compared with the operation of the same vehicle on pneumatic tires.

Here's a mechanical cranker that never runs down. It is built to spin tractor engines, and it does a thorough job

A Mechanical Engine-Cranker

THE latest type of farm tractor is assembled in the factory in much the same manner as an automobile, and when it gets to the end of its assembly conveyor, it is cranked up and run under its own power as a final test.

To perform this cranking operation one hundred times a day—which represents the output of one plant—is a hard task if done by hand, and a slow one in addition. To substitute mechanical for hand labor an automatic engine-cranker was evolved. The apparatus is made up of a swinging arm, pivoted so that when it is swung around perpendicular to the assembly conveyor, a special crank-grasping member fits over the regular crank handle. An electric motor is mounted on the swinging arm.

How to Prevent Traffic Accidents

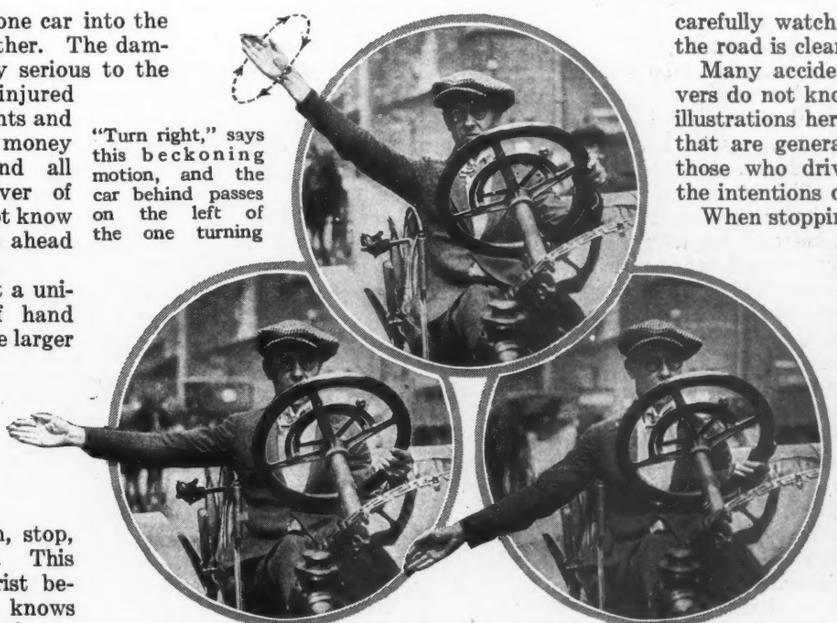
CRASH! goes one car into the back of another. The damage is not usually serious to the occupants of the injured cars, but head-lights and fenders cost big money these days. And all because the driver of the rear car did not know that the machine ahead was going to stop.

Why not adopt a universal system of hand signals? In all the larger cities of this country automobile drivers throw out a hand when they are going to slow down, stop, or turn a corner. This makes the motorist behind alert, for he knows the car ahead is going to do one of these things, and he slows down and carefully watches the car ahead until the road is clear again.

Many accidents result because drivers do not know how to signal. The illustrations herewith show the signals that are generally understood among those who drive, and which express the intentions of the driver.

When stopping or slowing down, the arm is extended straight out, but pointing toward the roadway. This tells the car behind that the car ahead is either slowing down or coming to a stop.

Holding the arm horizontally means that the driver is going to turn to the left. The driver behind may then veer over to the right of the road and pass by the car as it turns to the left. When turning to the right a sort of beckoning motion is performed.



"Turn right," says this beckoning motion, and the car behind passes on the left of the one turning

"Left turn," the arm is held straight out, and the car behind turns to the right and passes the first car

"Slow down or stop," this motion says, and the car behind waits until the road is clear before speeding up again

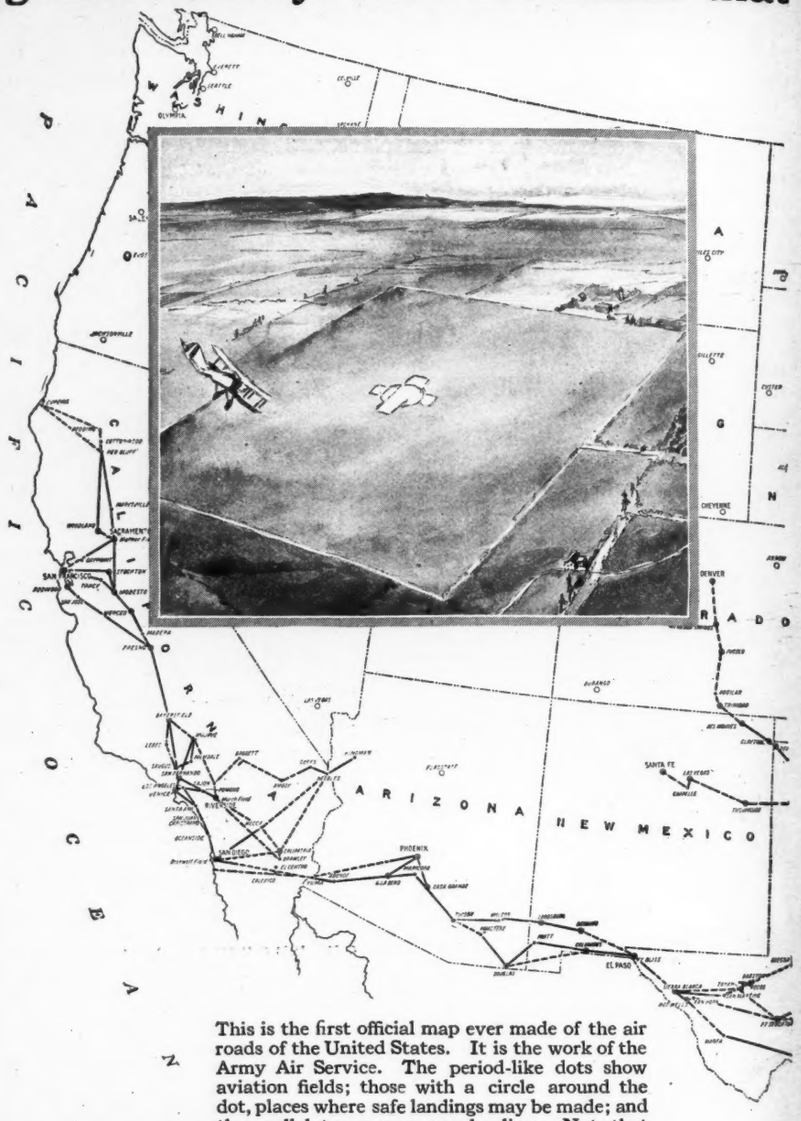
Laying Out Airways and Terminals that

A BEGINNING has been made in laying out the air roads. Some day they will cover a map of the United States with a network of lines as closely woven as those of the railroad maps of today. The chart shown here is the first official one of the aerial routes of the country. It is sponsored by the U. S. Army Air Service and represents routes flown and reported by army aviators.

The large period-like dots along the routes denote aviation fields; those with a circle around the dot, places where landings can be made with good chances of safety; and the small dots, fields where a hard-pressed pilot might try to make a landing in an emergency. Notice how few, comparatively, are the marks indicating aviation fields—real airway terminals.

That's the answer to those who ask when the airplane is to become a commercial reality. The machine is ready, but the landing places are not. And landing places are to the airplane what good roads are to the automobile—neither can get very far without them. How ready the machine is has been shown by the flight of the NC-4, by the transcontinental flight made by airplane over the southern route, and by the daily air mail service between New York and Washington; how few the properly prepared landing places is indicated by the Government's map.

In an effort to speed the day of the airplane as a real commercial factor, the United States Government has asked thirty-two cities to cooperate in the work of establishing landing fields. It makes a proposition to these cities that they build the fields, promising, if they do, to provide experts from the Air Service and the Post-Office Department to aid in the selection of sites, and to furnish a steel hangar to be erected at the field.



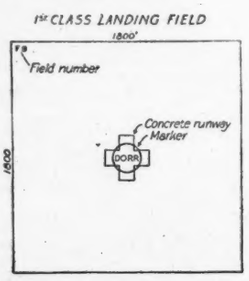
This is the first official map ever made of the air roads of the United States. It is the work of the Army Air Service. The period-like dots show aviation fields; those with a circle around the dot, places where safe landings may be made; and the small dots are emergency landings. Note that a considerable part of the West is still uncharted

While the government has confined itself to asking the aid of cities where aerial mail service stations are needed or where stations are required for the Air Service, any town that wants to build an aviation field will be encouraged to do so, with expert advice about building along approved lines. Here are the Air Service hints for aviation field builders:

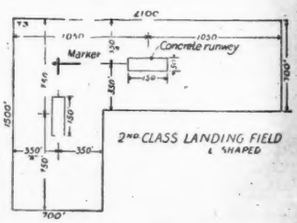
The field should be chosen so that transportation to and from the heart of the city to which it belongs will not take more than half an hour; it should be adjacent to good highways and near to car lines; it should have electric light, water supply, and sewerage; it should permit of expansion as the air fleets grow; it should not be where future building operations will be likely to shut it in.

As to size, the field must allow a 600-yard runway in every direction, with no interfering obstacles; in shape, square or rectangular; and the ground must be smooth and firm.

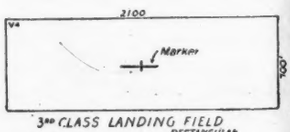
The fields will be divided into three classes. Those designated as of the first class will conform in every way with the specifications set forth above; those of the second class will conform in every particular, except that the shape is not square or rectangular. The third class will include fields less desirable than the others because of size and location, and which fail to meet the specifications along the following lines: where the ground is such that a take-off can be made only under certain weather conditions; where accommodations do not include hangar space; where supplies are available only on request; where the field is so situated that help



First-class landing fields must have a 600-yard runway in every direction and be square or rectangular in shape. They are marked with a great white circle

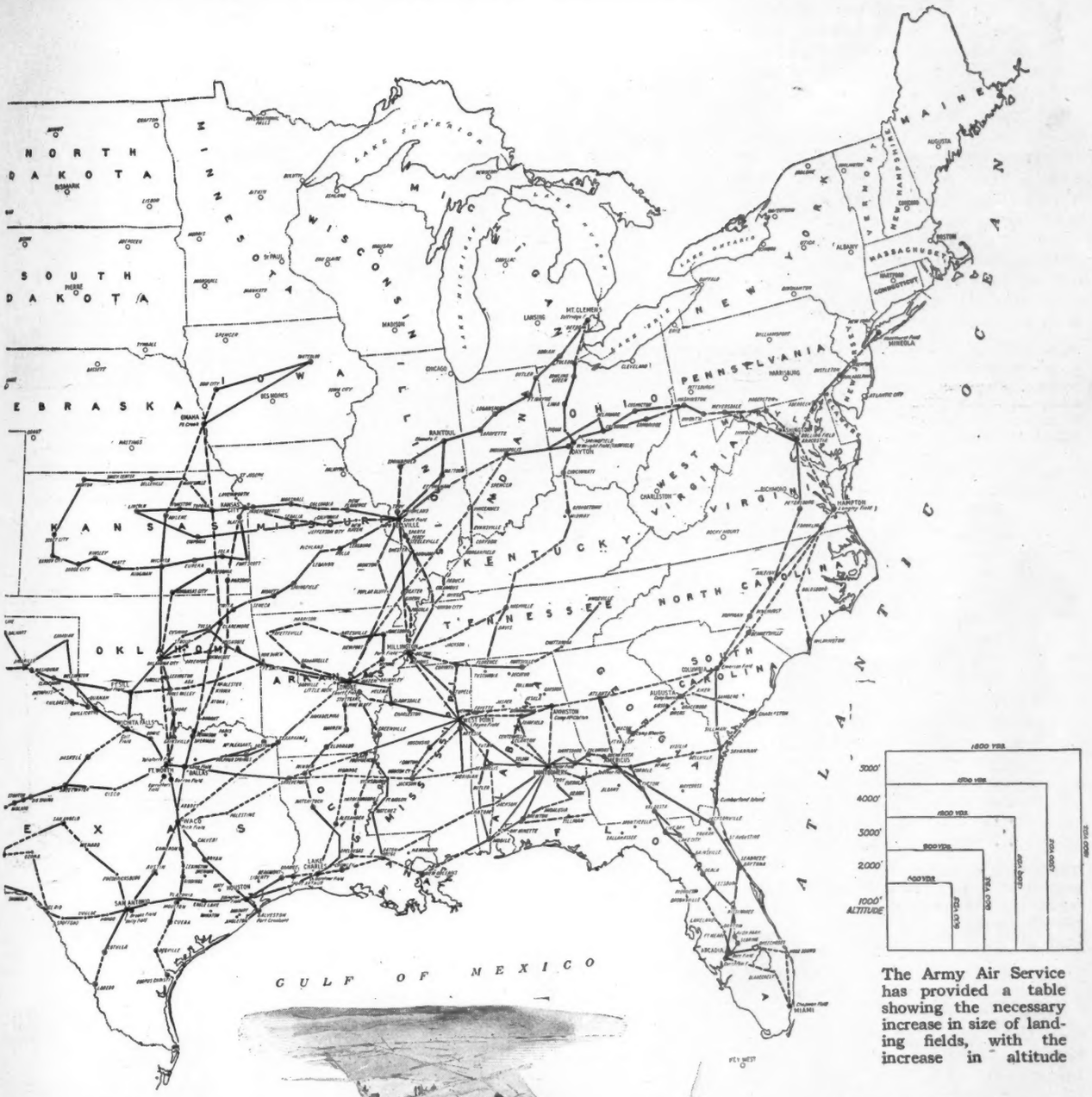


Second-class fields differ from those of the first class only in being neither square nor rectangular. They are marked by a cross of arrows indicating the shape of the field

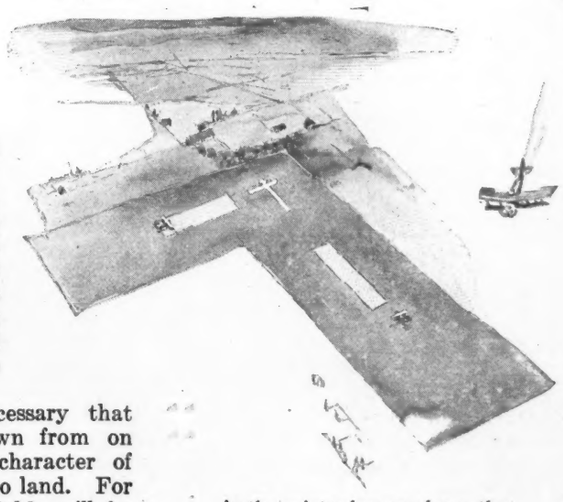


A plain cross is the mark of a third-class field. It is arranged so as to indicate the shape and size of the landing place

Will Open Up the Skies to Commerce



The Army Air Service has provided a table showing the necessary increase in size of landing fields, with the increase in altitude



As the aviator hovers above, the cross of arrows tells him that he is over an L-shaped field of the second class, and the arrows show the longest runway

will be available only on request.

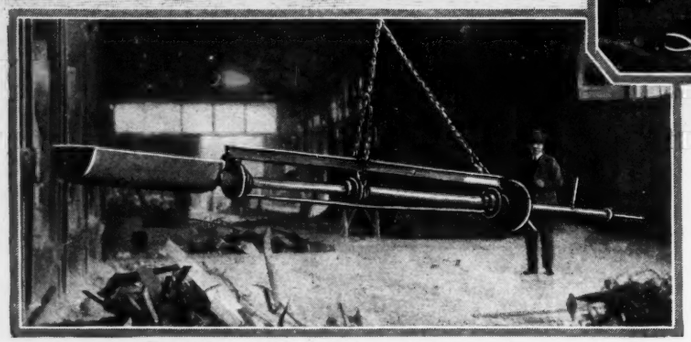
Third-class fields must, however, have provision for guarding airplanes and must have telephonic communication with the city. Fourth-class flying fields are those that should be used for landing in case of emergency only.

Of course, it is necessary that the aviator looking down from on high should know the character of the field on which he is to land. For this purpose first-class fields will be marked with a circle one hundred feet in diameter, with a band three feet wide; second-class fields, a cross arrow with bars three feet wide, each bar ninety feet long if the field allows six hundred yards runway, and of proportionate length if the field is under that. Where the field is L-shaped the bars will cross each other proportionate to the length of each arm of the L. Third-class fields will be indicated by a plain cross of a size and length of arms proportionate to the length of the runway and the shape of the field. Emergency landing-fields will be marked with a single arrow indicating the best approach and longest runway. All markings should be in white.

Do It with Tools and Machines

Take fourteen men from your crew and put them on the boom of your back-filler. If it won't budge it proves the design is suited to efficient work

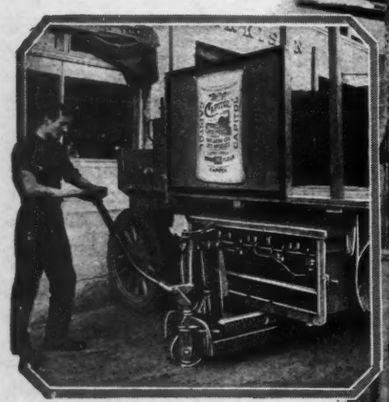
With pistol grip and trigger switches this lightweight drill resembles the famed army Colt automatic gun. It weighs only twenty-seven pounds



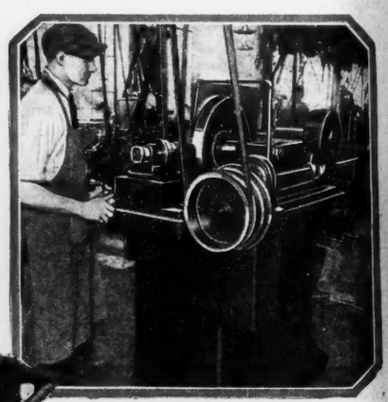
The large metal box on the end of a carrying apparatus is filled with scrap metal and pushed into the furnace, where it turns over, allowing the scrap to fall out

The holders of this contrivance support the sack exactly as would human arms. The shoveler may adapt the bag height to his individual stature

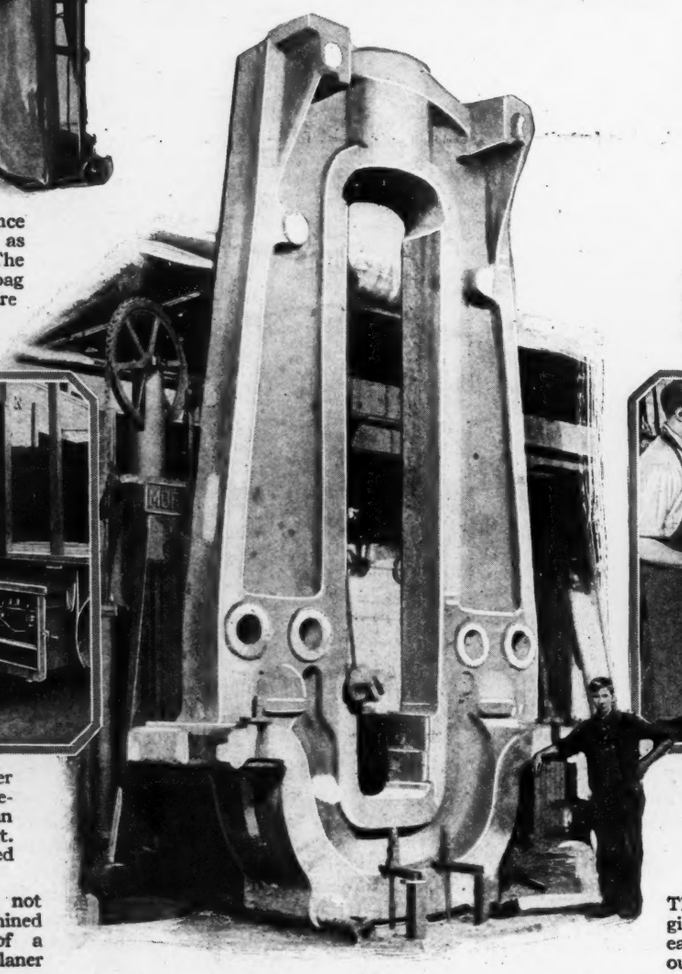
The rivets are set into place cold, and are heated by electrical current from a transformer. It takes one thousand amperes fifteen seconds



The jack-lift is backed under the battery cradle and elevated until the hooks can be swung out of attachment. A six-inch lift is required



This machine rounds one side of the teeth of an automobile fly-wheel in eight minutes. The fly-wheel carries 156 helical teeth



Big—yes! But not too big to be machined in one set-up of a new draw-cut planer

The machine handles gigantic castings with ease and despatch without regard to shape

Lightening the Housekeeper's Tasks

Designed to give the baby both exercise and amusement is this practical rocker. Another advantage is that it cannot possibly topple over

Opened and in use, this go-cart, shown at the right as a compact light bundle, accommodates not only the baby, but also the baby's doll

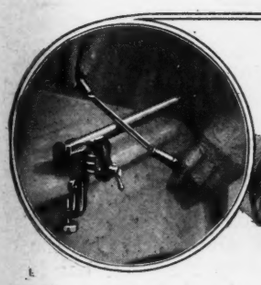
When the baby decides to walk for a change, the go-cart is easily carried by the nurse. But what has become of the doll?

Why not use an old umbrella-frame for drying small pieces? It takes kindly to clothespins, and will surprise you with the amount of wash it accommodates

These light-weight aluminum mittens, which attach to the baby's wrist, prevent her from scratching in case of any skin affection like eczema or measles

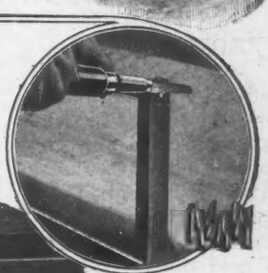
Adaptable to the seat of any large chair, it makes you as well as the baby comfortable throughout the meal

One of the terrors of wash-day is the filling and emptying of tubs. With this vacuum device attached to the faucet, the tub water runs back into the sink



Who ever saw a vise as tiny as this one? It stands only two inches high and can be screwed to the kitchen table. It will firmly clamp any small article

If your apartment boasts only one bed-chamber and an unexpected guest arrives, you have only to turn this chair into a comfortable bed

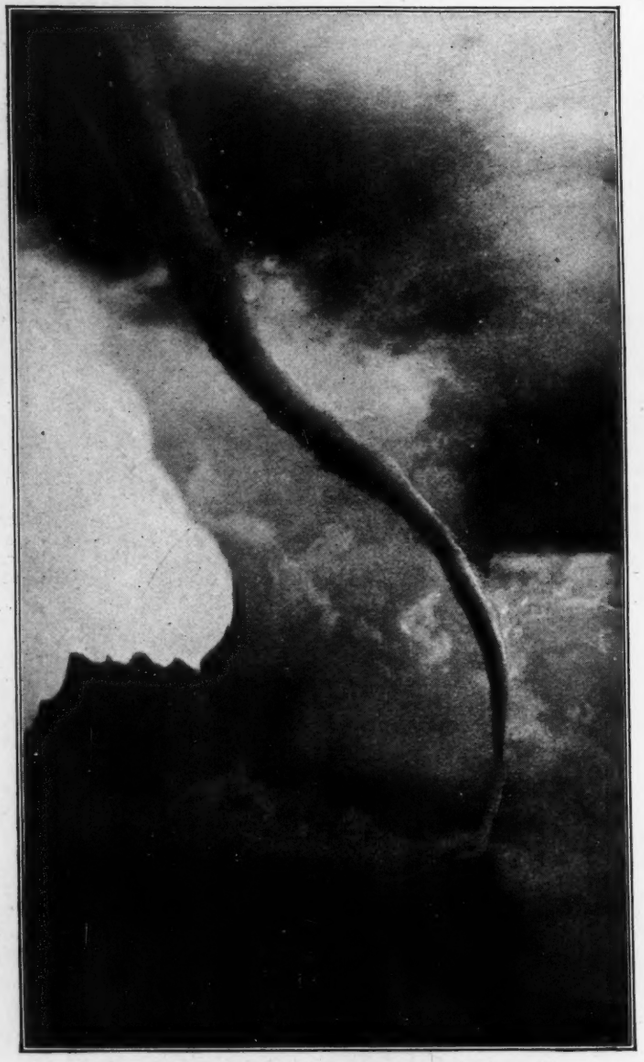


This three-inch saw fits into the tool handle so that it may be used effectively on anything from a ham-bone to spare ribs

"It Looked Like a Huge Column of Smoke—"

THE art of photographing tornadoes is still in its infancy. Tornadoes have a pronounced aversion to sitting still and looking pleasant. They are excessively rare visitors in any given locality, and generally the heavy clouds by which they are attended shed such darkness round about that a good photograph is almost unobtainable.

The accompanying photograph is probably the clearest and best ever taken of a tornado funnel-cloud. Mrs. Charles S. Aldrich, of Elmwood, Neb., writes us that it was taken at that place on April 6, 1919, by a high-school boy, whose camera was too small to get all of the funnel in one picture: hence he took the upper and lower parts separately, in quick succession, and a professional photographer put the two negatives together. The dark splotch at the lower end of the funnel is where a farmhouse of stucco is being twisted off its foundations. The writer says:



"At first we thought it was a fire; but immediately a terrific rattling told us it was a tornado"

"When we first saw the upper part of the cloud, it looked like a huge column of smoke, so that our first thought was of a big fire. But immediately the noise, like a terrific rattling (much as I imagine machine-gun fire must be), gave us the knowledge that it was a tornado. It was preceded by a hail-storm,—some of the stones nearly reaching the proverbial hen's-egg size,—but there was no rain or hail while the cloud itself passed near the town. It came within a quarter of a mile, apparently headed straight for us, and then appeared to veer in its course. It destroyed many farm buildings, leaving things in kindling-wood where it passed. We watched it flatten out and dissipate itself, as smoke would, all over the landscape."

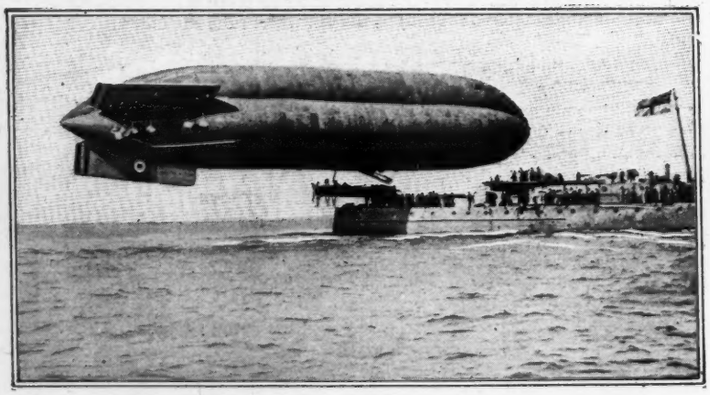
A tornado is a waterspout on land. It is a very powerful local vortex in the air, always beginning at a considerable level above the earth and working downward. Within the vortex the air is rarefied by centrifugal action, and is cooled in consequence of its rarefaction. This cooling causes the moisture in the air to condense in the form of a more or less funnel-shaped cloud, which shows the position of the vortex. The actual shape of the cloud varies. It has been described by observers as "balloon-shaped," "basket-shaped," "egg-shaped," "trailing on the ground like the tail of an enormous kite," "like an elephant's trunk," etc. It is often seen to twist and coil like a snake.

The speed with which the air revolves in the tornado whirl has been estimated, from its effects on masonry and other structures in its path, at upward of five hundred miles an hour in some cases. The tornado as a whole, however, travels over the ground at a much more moderate speed—perhaps forty miles an hour, on an average.

How a Blimp Manages to Live on a Battleship

FROM little gas-bags great blimps grow; and so by making room for the gas-bags British battleships are able to house the blimps. Each blimp is assigned a small space on deck—just about large enough to hold the car it carries. Then, when the blimp comes home after a day's work of policing the ocean, she is promptly deflated and tucked in her car.

The British dirigible is built on principles directly opposite to those used in constructing the German Zeppelin. The Zeppelin is rigid, the blimp non-rigid. In the Zeppelin, the framework and outer bag are made of aluminum. In the blimp the outer bag is made of cloth. Inside there are several *ballonnets* which are filled with gas. The outer case is made stiff by compressed air, fed to it by the pilot in the car beneath.



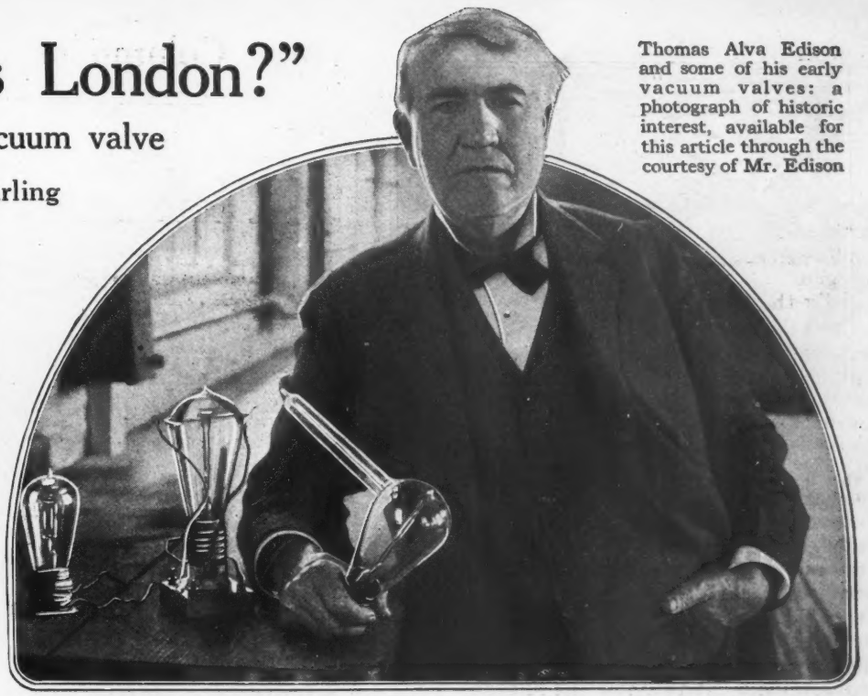
© Keystone View Company

The blimp has just been launched from her mother battleship

"Hello, Is This London?"

The momentous vacuum valve

By Lloyd E. Darling



Thomas Alva Edison and some of his early vacuum valves: a photograph of historic interest, available for this article through the courtesy of Mr. Edison

"WITHIN three months," said Marconi recently, "YOU, from your hotel room in London, will be able to call any New York telephone number, get it inside of fifteen minutes, and then talk three minutes for five dollars." What will make this possible? The vacuum valve. And it is going to make many other things possible. In fact, few inventions are of more portent in these times than the vacuum valve. And few inventions have had a more obscure history and origin. This is the first article to assemble material from original and authoritative sources, and to present an unbiased account of the evolution, present status, and future of vacuum valves, and of the men who made them what they are.—EDITOR.

UNLESS you are a radio amateur, or a man who has followed the development of the electron theory on the relations of electricity and matter, you will probably wonder what a vacuum valve is, and why the newspapers haven't had front-page articles about it.

Yet, if a fly takes a notion to buzz around a telephone transmitter in San Francisco, the vacuum valve is the contrivance that will faithfully reproduce the sound-currents at intervals along the great transcontinental telephone line, and, getting them to New York, is capable of amplifying the sound so that the walls of a room will reverberate as if a low-flying airplane had come into the neighborhood. The same thing is true of a man's voice, and they may even do it *wirelessly* from San Francisco to New York, or even from Honolulu, Hawaii, to New York, if they like, though they aren't doing it as a regular practice —yet.

How Fliers Talk to Each Other

Then, too, the vacuum valve is the contrivance that enables the transatlantic naval fliers to talk among themselves and to ship and shore stations on the way over—a feat that may be done regularly in aerial and ship navigation in the near future.

Our huge commercial wireless stations profit through vacuum valves, getting messages with ease from the far corners of the earth. With a vacuum valve, even small stations and indoor aerials can accomplish wonders. The valve enabled the President to stand on the White House lawn, a few months ago, and, in an ordinary voice over a radiotelephone, to direct the flight of aviators thousands of feet in the air and out of sight at times. Secretary Daniels has sent orders to battleships out at sea with the radiotelephone, his voice being heard by the commanders just as clearly as if he were talking over an ordinary nickel-in-the-slot telephone.

Vacuum valves may possibly enable you and me to sit in our homes of an evening and hear a machine on the table reel off the day's news, or the opera that a prima donna in a near-by city may be singing at the moment. We may even save time by hearing it all from a loud-speaking telephone while riding home on the subway or street-car line, the cars being in motion. Major-General Squier goes and drives a nail in a tree, connects apparatus of which vacuum valves are a part, and hears radiotelegraphic messages from all directions, as well as radiotelephonic messages, if there are any.

Dr. Lee De Forest's especial contribution to the vacuum valve art was the "third electrode," or "grid." He called his valve an "audion." Here he is manipulating several

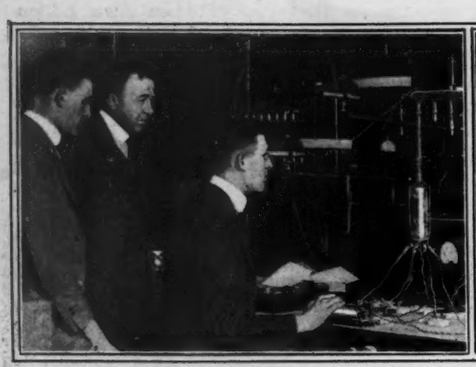
What Marconi Said

The valve is so sensitive that it makes almost unnecessary the high towers we have come to associate with great wireless stations, though they are not in the way if one has them. At present the valve is only in its infancy. Every month new applications are being discovered. It is possible even to transmit power wirelessly with the vacuum valves, though inefficiently at present.

Marconi himself is credited with saying, a short time ago: "Within three months, you, from your hotel in London, will be able to call any New York telephone number and get it inside of fifteen minutes, and then talk three minutes for five dollars."

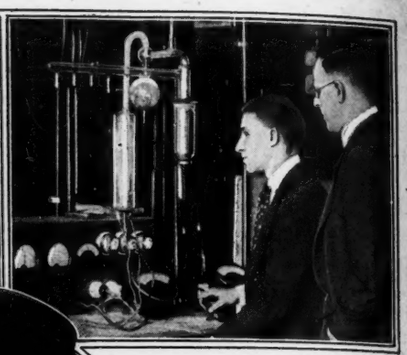
Surely, if you haven't heard much about vacuum valves in the newspapers, you will soon.

Vacuum valves are not exceptional in appearance. A common form greatly resembles a ten-watt tungsten lamp, the kind the landlady puts in the hall lamp to save current; but it has more wires and plates and one thing and another on the inside than a ten-watt tungsten light. Other forms of vacuum valves are larger than an X-ray tube, and resemble it in general appearance. Details of this are made clear in the illustrations on page 69. The "vacuum" part of the valves' name comes from the fact that the air is exhausted from their interior, as in the ordinary incandescent lamp. The "valve" part of the name results



Vacuum tube gas pressures of a few billionths of an atmosphere being measured under the supervision of E. H. Colpitts and Dr. W. Wilson

(*Right, center*)—Drs. H. J. van der Bijl and C. J. Davisson consider a vacuum valve of unusual kind. This one radiates 100 watts. It will receive and modulate as well



Dr. H. D. Arnold has mastered getting the high vacuum necessary for perfected vacuum valves

from the peculiar valvelike action that the bulb and its contents have on some kinds of electrical circuits, a feature that will be made clearer later.

It is interesting to consider the history and inception of the vacuum valve. We want to know the lineage of a contrivance so fraught with wonderful accomplishments and possibilities.

Edison—who else would you suppose—devised the original vacuum valve? Even he himself did not realize all that he had produced at the time. In October, 1884, Professor Edwin J. Houston gave a talk before one of the first meetings of the American Institute of Electrical Engineers ever held. Said Professor Houston:

> I wish to call your attention to a matter which, I suppose, you have all seen and puzzled over. Indeed, I wish to bring it before the society for the purpose of having you puzzle over it. I refer to the peculiar hi[illegible] vacuum valve phenomena observed by Mr. Edison in some of his incandescent lamps. I have in my hand an Edison incandescent lamp. This one, however, has, in addition to the carbon filament, a platinum plate or strip, thoroughly insulated from the filament, and supported between its two vertical parts.
>
> The lamp being lighted by an electrical source, a current will flow in the direction indicated by the arrows. If the filament is just ordinarily bright, no unusual effects are noticed. If, however, the incandescence of the filament is raised from its normal eight candlepower to twenty—, thirty—, forty—, fifty—, or one hundred candlepower, then the needle of the galvanometer is violently deflected by a current passing through its part of the circuit. I have no theory to propound as to the origin of these phenomena. I wish merely to call your attention to the phenomena. At one time Mr. Edison devised other bulbs with long tubular projections at their sides [the kind Mr. Edison is holding in his hand in the photograph. Ed.] Instead of placing the platinum plate between the legs of the filament as before, he placed it at the far end of this tube, and obtained the same general effects as before, even though the tube was surrounded by a freezing mixture.

There followed much general discussion at the meeting, and the propounding of many explanatory theories, most of which would hardly hold in these days.

Dr. J. A. Fleming, F.R.S., of London, England, who applied Edison's vacuum valve to the broad radiotelegraphic field

Edison has received but very little credit for discovering the valve. He was still working on his electric light at the time he produced it—making those wonderful discoveries that resulted in the forming of a whole new industry, modern electric-lighting and power-distribution.

At the moment of producing the valve, Edison happened to be investigating the deposition of carbon on the inside of the bulbs, and trying to determine the reason for the sharp shadows of the filament sometimes seen. There was also a bluish tinge that aroused his curiosity.

Presently he thought of placing a plate near the filament to see whether currents were being developed simultaneously with these other effects. He discovered that there were. There you have your vacuum valve.

The fact that currents could be carried across a vacuum, and more strongly in one direction than in the other, was startlingly new at the time. Much scientific excitement was created both in America and in Europe.

Lieutenant-Colonel F. B. Jewett, chief engineer of the Western Electric Co. He and the heads of his organization, shown above, perfected vacuum valves for trans-continental telephony and the war's uses

Edison was too busy with electric lights to go much further with the discovery then, and he was side-tracked to something else afterward. But the phenomena he had discovered—that the region surrounding a hot filament *in vacuo* was electrically conductive, and highly one-way at that—became known as the "Edison effect," after the work he had done. He utilized the vacuum valve practically in 1883, however, in recording changes in electrical pressure in his first New York power-house.

Not much other use was made of vacuum valves until about 1904, when it occurred to Dr. J. A. Fleming, of London, to put them in radiotelegraphic circuits as rectifiers of incoming oscillations. This was a long step. Says Dr. Fleming:

> The starting-point for the invention was the interesting observation made by Mr. Edison in the early '80's. In 1885 Sir William Preece read a paper before the Royal Society on his further investigations. I examined the "Edison effect" at still greater length in 1889, 1890, and 1896 in papers read to the Royal Society and to the Physical Society. I came to the conclusion that the phenomenon was due to the emission of negatively charged atoms or molecules from the filament. In those days the conception of an electron, or particle smaller than an atom, had not been reached, and it was not until after Sir Joseph Thomson's epoch-making researches that it was recognized that the particles emitted were not atoms of matter, but atoms of electricity 2,000 times smaller.
>
> In 1904 I was endeavoring to use a mirror galvanometer, of the kind used in submarine telegraphy, to detect wireless signals; but this required that the movement of electricity in the galvanometer circuit should always be in the same direction. Receiving circuit oscillations are, however, alternating currents of very high frequency, and with these both the mirror galvanometer and the telephone receiver are inoperative. A rectifier was vitally necessary. I found after careful experiment that the vacuum valve would rectify these oscillations satisfactorily. It then became possible to utilize a receiver or the galvanometer with ease.

As a result of Fleming's work the device came to be known as the "Fleming" valve. Yet, as is evident, it was the old valve of Edison's, even though Edison did not apply it to the radiotelegraphic field, highly important as that application was.

It may be said in passing that the American—Edison—deserves credit in another branch of radiotelegraphy also; that is, for being the "godfather," so to speak, of the whole science of modern practical electric wave propagation, the thing upon which all radiotelegraphy and radiotelephony depends. In the late '70's—even in those early times, electrically speaking—Edison had discovered that you could get electric waves from an electric buzzer—a fact that any youthful wireless experimenter knows now.

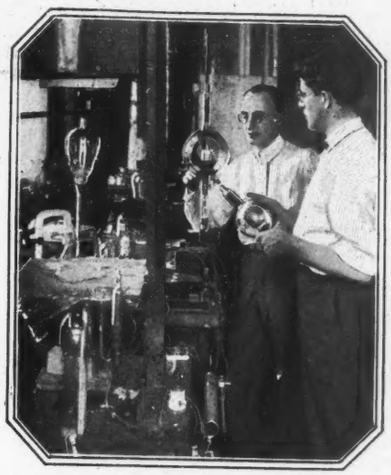
At the Paris Exposition in 1881 Edison had a buzzer contrivance rigged up, the waves being sufficient to cause small sparks between the ends of graphite pencils in a darkened box.

Thousands of visitors saw the apparatus, one Heinrich Hertz among them. He went home to Germany, elaborated the idea, rigged up improved apparatus, studied the results, and presently the noteworthy work of Hertz on electric waves was published. Since then you have heard of Hertzian waves, and Hertzian this and Hertzian that, all with some scientific justification, for the work of Hertz really was invaluable. But as a matter of historic accuracy we should evidently speak of "Edison waves" and such; for Edison was the man whose experimenting, penetrating, everlastingly trying something mind first made them materialize, though Maxwell, the propounder of the electromagnetic theory of light, thought all along that they must exist.

To Edison, as the first man who ever devised a vacuum valve, and the materializer of electric waves, the whole radio profession owes an immense debt.

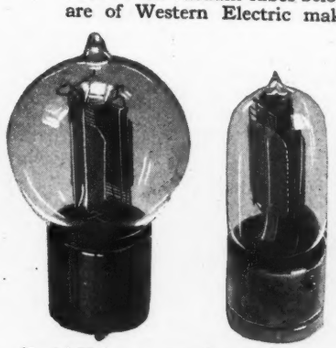
As is evident, the vacuum valve has had a good many ups and downs in its history. But the valve would hardly have attained its present-day importance had it not been for one other episode in its career. This was the production, about 1905, by Dr. Lee De Forest of New York, of a vacuum valve containing a third electrode: i.e., a bulb having one other metal part, or "grid," on its interior, in addition to the hot filament and plate of Edison's valve, and the one used by Fleming. What a third electrode does is told by the drawings on Page 70.

Immediately there arose much dispute and patent litigation between the interests owning the Fleming patents and Dr. De Forest as to priority in applying the vacuum valve to the radio field. Only recently did the courts finally decide the case, giving Fleming the credit for having first accomplished the application.

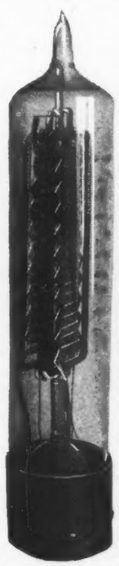


Dr. Irving Langmuir and Dr. Saul Dushman, of the General Electric Research Laboratory. This company's men have produced the "kenotron," a two-electrode valve, the "pliatron," a three-electrode valve, and the "dynatron," a noteworthy vacuum tube having negative resistance

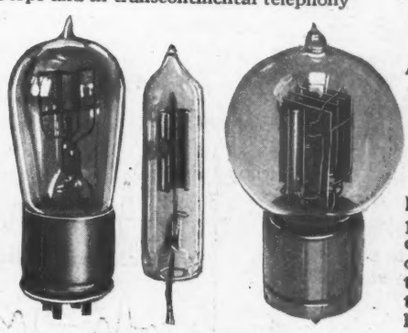
Five of the vacuum tubes below are of Western Electric make



(*Left*) Voltage amplifier or detector of pre-war type. (*Right*) Signal Corps airplane radiotelephone tube, ruggedly constructed. 2.5 to 3.5 watts heats filament. Plate, 20 v. 25,000 a week made at war's end

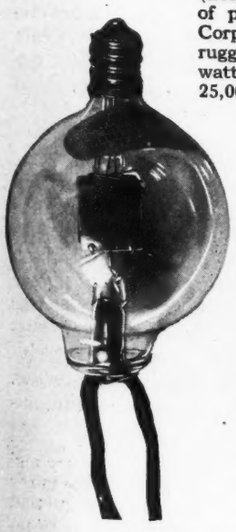


They were used in the American Signal Corps and in transcontinental telephony

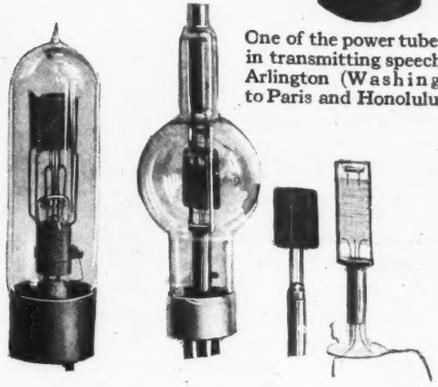


(*Left*) General Electric small transmitting tube rated at 5 watts, 300 volts. (*Center*) Unusually small recent detector and amplifier. Filament, 1 v., 0.18 amp. Plate voltage, 10

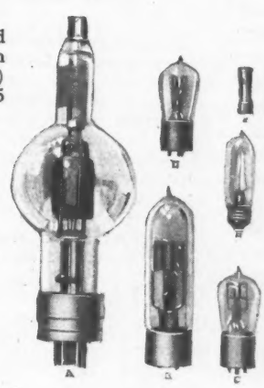
At the left is one of the vacuum tubes for San Francisco-New York talks. This is a Western Electric telephone repeater of the type used on the great transcontinental telephone lines daily



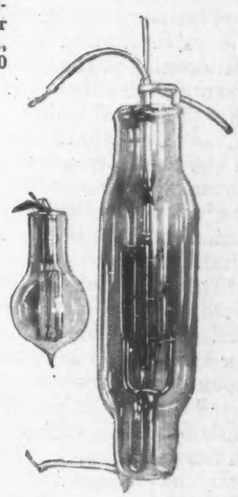
An audion of before-the-war design — now an old-timer. This was an improved form called an "ultra-audion" by De Forest



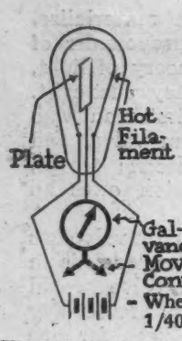
One of the power tubes used in transmitting speech from Arlington (Washington) to Paris and Honolulu, 1915



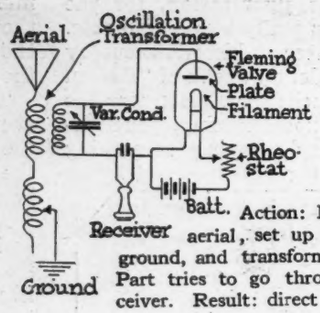
General Electric vacuum valves. At left, medium-sized transmitting tube, 50 watts, 750 volts. Center, large-sized transmitting tube and parts, 250 watts, 1,500 volts. At right, comparative size of tubes. D is a receiving tube; E a ballast lamp; and F a grid leak resistance



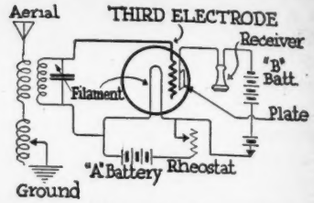
Large and small De Forest radio oscillion bulbs used for transmission of varied messages—late types evolved from the audion



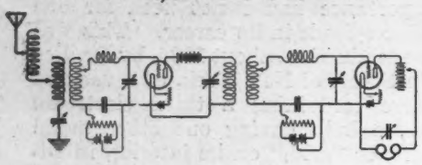
Edison, in 1883, put a plate in a carbon-filament lamp. With filament overheated a current would begin to flow, apparently from plate to filament, if "movable galvanometer connection" was on positive side of battery. When on negative, only 1/40th of this flowed

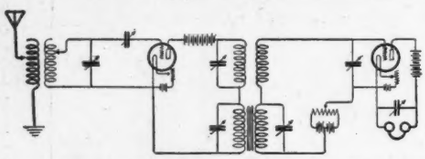


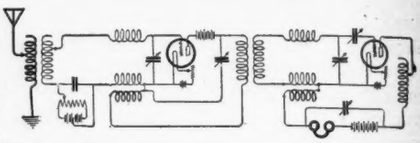
Fleming applied Edison's valve to radio telegraphic circuits, as at left. This was much more effective than the coherers and crystal detectors of other years. Action: Ether waves strike aerial, set up currents aerial to ground, and transformer to condenser. Part tries to go through valve to receiver. Result: direct current in receiver



De Forest added "third electrode," or "grid," in the manner here shown. This was a big improvement and most valves of today are of this type. The valve's complete circuit is also plain







The three diagrams in this row are after "Bucher, Vacuum Tubes"

This cascade amplification demonstrates complicated circuits attendant to higher applications of vacuum valves. Here output circuit of the left valve is connected to input circut of the valve at right

Further complication. Here audio and radio frequency oscillations are amplified by a cascade connection. "Audio frequency" oscillations are those under 10,000 cycles per second—"radio" those over

Amplified radio frequency component of plate current of left valve is impressed upon filament of the right valve, where it is further amplified by a second regenerative coupling. Grid condenser then traps it

De Forest, however, is the undisputed discoverer, or inventor, of the third electrode idea and principle, an addition as valuable to radio as the application of the valve itself to that art.

On long-distance telephone lines they use the valve as a "repeater," which application is somewhat different from the valve's service in radiotelephony. Currents on long telephone lines easily become diminished and unrecognizable. So at intervals some device must be installed that will set in motion fresh currents in the line, the currents started by your own voice controlling them. Until De Forest's third electrode valve was evolved, only mechanical repeaters existed—unsatisfactory instruments. Perfecting the valve allowed commercial opening of the transcontinental telephone line in 1914. Several other contrivances go into the making of the transcontinental telephone line practicable, but the valve was the last perfected, and one of the most vital.

The valves of De Forest were excellent detectors of radio signals, but depended for their action as detectors upon the presence of a small amount of gas in the bulb, and their operation varied with variations in the gas pressure. They were inherently low-voltage and hence low-power devices, because of the fact that if voltages appreciably above the ionization voltage of the gas were applied to their electrodes, they would burst into a blue glow and cease to operate. These peculiarities barred them from uses where an appreciable amount of power is required.

Dr. Irving Langmuir, of the Research Laboratory of the General Electric Company, found means whereby valves can be produced that may be operated with any voltage desired, without the bad effects of gas ionization. Many of the radio sets using these valves have been operated at fifteen hundred volts or more. The former limitations to their use when appreciable amounts of power are required were thus removed, and the wide fields of wire telephony and radio transmission opened up.

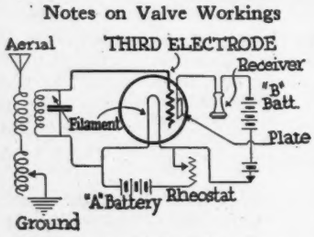
Dushman, White, and Hull of this organization did valuable work and university laboratories have contributed materially also. In fact, perfecting the vacuum valve has been the joint work of many.

In the great war organization of the Western Electric Company, and before, very important discoveries and perfections were made. The names of Carty, Jewett, Craft Colpitts, Arnold, van der Bijl, and many others came prominently to the fore.

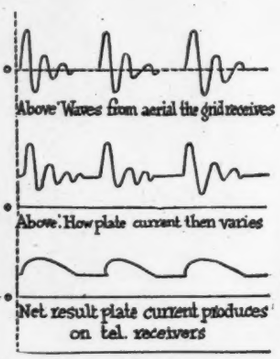
This organization's activity raised the war-time production of vacuum tubes from the existing one or two hundred tubes a week of 1917 to a rate of more than a million and a half good tubes a year at the time the armistice was signed. This necessitated establishing factories and training thousands of employees.

Radiotelephonic communication to and from airplanes was brought about; radiotelephonic communication over such long distances as from Arlington, Va., to Paris and Honolulu had already been accomplished as a test. De Forest's laboratory also aided war work materially.

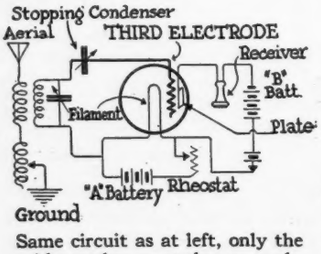
Notes on Valve Workings



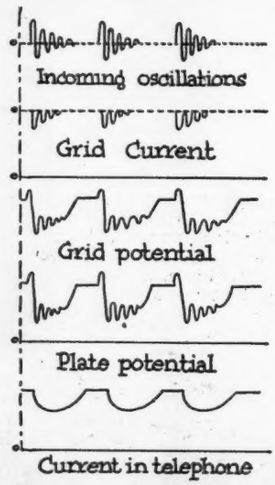
Suppose aerial picks up a signal. Radio frequency alnating voltage is thereupon impressed between filament and grid. What happens is shown in the curves below


Above Waves from aerial the grid receives
Above How plate current then varies
Net result plate current produces on tel. receivers

Middle curve shows what top curve does to plate current. Receivers only respond to contour of middle curve. To them middle curve looks like bottom curve. These curves and ones at right from "Radio Communication," a book written by Bureau Standards for the Signal Corps, More advanced discussions are in Proc. Inst. Rad. Engrs.



Same circuit as at left, only the grid now has a condenser, making action different. When the grid becomes positive, electrons flow to it, but when negative, none comes. (See curves below)



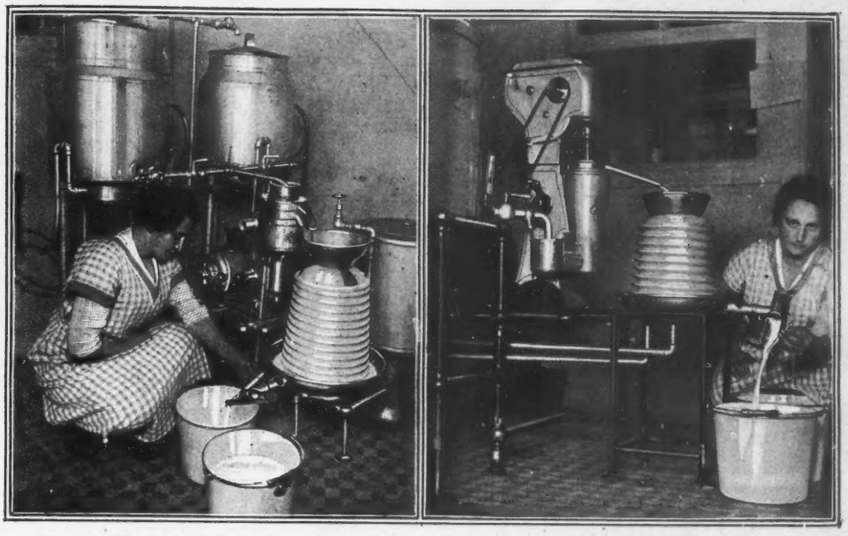
Thereupon "grid current" curve results. Grid continues gaining negative charge, see "grid potential" curve. Next should read: "Resulting plate current"

Keep the Milk Clean

IF you leave a can of fresh milk uncovered, bugs, dust, and germs will settle on its surface. Yet it is not advisable, while milk is warm, to exclude air. The problem is solved by the ventilating lid shown below.

A partition extending through the center of the lid divides it in half. In each half there are air-holes, those in one side being placed higher up than those in the other side. The air enters the lower holes, goes down the partition, crawls under it, and creeps up the other side, to emerge from the upper holes.

Thus the milk gets its ventilation, and is at the same time free from all but the most venturesome bugs, dust, and germs. And, since germs do not show, the milk's surface remains quite clean.



Milking the mechanical cow. This modern milkmaid is reconstructing milk that was reduced to powdered form to cut down shipping costs and so the price to you and me

While father milks the cows his son plays with the milk-can lids; these lids have air-holes and central partitions which ventilate the warm milk and yet keep it clean

Mechanical Cows to Cut Milk Cost

AND the price of milk keeps going up! The cow is not to blame—she hasn't raised her prices; the farmer's share of the blame is small. Most of it may be heaped on the shoulders of transportation. But transportation has its woeful tale to tell, and so the problem is yet unsolved.

Milk is nearly ninety per cent water; and this fact has caught the attention of the milk bureau of the Department of Markets in New York. Why not take out the water before the milk is shipped, and put it back again after it arrives? Then milk will need only one tenth of the freight space now necessary.

Chemists working on the problem have found the following method most practicable. First they remove the insoluble fats contained in milk; then the remainder is evaporated *in vacuo;* this leaves casein, albumen, milk-sugar, and other organic and mineral contents in the form of a fine powder.

This powder is shipped in cans from farm to city, and then sent to laboratories, where it is reconstructed. The proper quantity of fat is added in liquid form and thoroughly mixed so as to form a smooth emulsion. This emulsion is pasteurized to destroy germs and is cooled in a refrigerator. Then the water is added.

Seven pounds and three ounces of powdered milk, dissolved in ten gallons of water and thoroughly emulsified with six pounds and three ounces of sweet butter, will make one hundred quarts of 3.3 per cent milk.

Sealing the Lid Tightly to the Can

YOU buy canned meat, canned fruit, canned vegetables, and yet never worry about poisoning, even though the cans are made of tin. Why? Because they are so carefully sealed that no air can get in.

This confidence in canned food did not always exist. But the canning industry has reached a high state of efficiency, and one of the most important branches is the proper sealing of the cans. Here are some of the newest sealing devices, all of which are highly efficient.

One of these is a self-heating capping tool which has its own gasoline tank and heater for soldering. Another is a crimping-machine for crimping the lids on glass jars. This is done before the sterilizing process takes place. The third and largest machine seals the tops on the cans automatically, without the use of heat and solder. It weighs thirty-eight pounds.

Here is a self-heating capping tool for tin cans that has its own gasoline tank and heater for soldering; it is a small but very efficient time-saver

This machine seals automatically without the use of heat or solder. It is the largest of the machines here presented, and weighs thirty-eight pounds

One pull of the handle crimps a tin top on a glass jar; the jar is then ready for the sterilizing process

Dates that Come in Bunches

THE date-palm of the Orient has made itself quite at home in Arizona. This is truly remarkable, since date-palms are not good mixers and don't take to foreign soil. In fact, dates have simply refused to ripen on the Mediterranean shores of Europe. But Arizona is dry, somewhat resembling conditions in Africa and Asia, where date-palms grow.

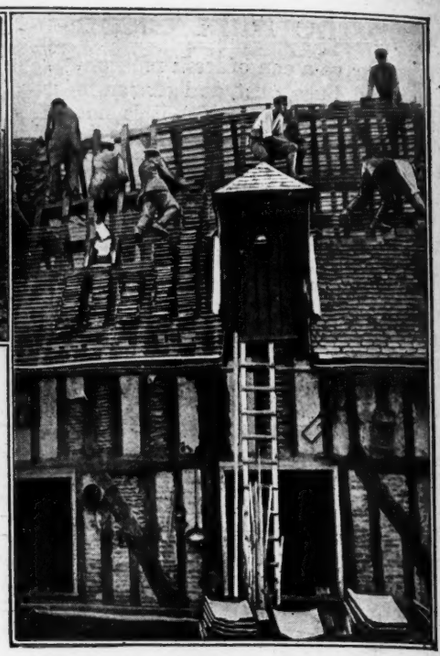
The dates grow in huge bunches that hang juicy, and are very delicious when eaten down below the leaves. They are large and fresh. It is quite probable that before long the United States will no longer have to import dates.

A Pine-Tree Melodrama Is Discovered

IN this exciting drama, mother nature plays heroine, a pine-tree the villain, and an old oak the tortured hero.

In Act 1, the young pine-tree breaks, and falls against the oak, piercing the oak's bark. Intent on saving its own life, the pine, at the expense of the oak, continues to grow right through the oak till it comes out at the other side. Act 2 reveals the pine evilly thriving while the oak droops from loss of strength. The pine-tree in the wound is sapping the oak's vitality. Then old mother nature arrives on the scene.

In the third and final act mother nature chokes the pine-tree to death, heals the oak by drawing the bark out over the wounds, and departs after the oak has fully recovered. Who can say that a tree's life is not exciting?



A Case of Poetic Justice

JUSTICE is coming into her own in that German prisoners, who up to the time of their capture had been doing their utmost to destroy towns, factories, and machinery in France and Belgium, should be given the work of repairing the very structures they were so anxious to see destroyed.

Throughout the miles of devastated territory there is work enough to keep armies of men busy for ten years, and even then only a comparatively small part of the permanent damage will be repaired. In some of the regions it is necessary to build quarters for the prisoners before they can go ahead with the work.

Great as was the destruction, it has been estimated that the United States, by saving its present industrial waste ($50,000,000 a day), could pay off the material cost of the war in two years.

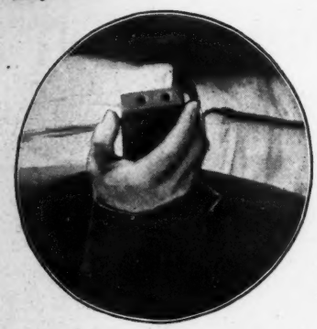
Pulling Albert's Tooth

ALBERT had a toothache—a bad one; he could neither eat nor sleep. It was a case of a neglected cavity which had grown entirely too large to be filled. But Albert really could not be blamed, since he is but a circus elephant. At any rate, the tooth had to be pulled.

So the veterinary gave him a large-sized dose of cocaine, adjusted a pair of forceps about the size of ice-tongs, and tied a rope to them. Then he lined up several husky trainers, and at a given signal they all pulled.

A long pull, a strong pull, and out came the tooth. It was about the size of a man's fist.

"There! It didn't hurt a bit," said the dentist.



You Can Own Your Own Wireless Lamp

WHAT does a red light and what does a green light mean? Danger and safety on land, port and starboard on sea, you promptly say. That is true in most cases, but not in the case of the small flash-lamp shown herewith. The red light means dot, and the green light dash, and they represent the dot and dash of the telegraph signal system. The lamp is a new telegraphic apparatus which may be used effectively up to a distance of a thousand yards.

One rolling key controls both lights. You turn it one way and the red light will register; you switch the other way and the green one lights up. The lamp was invented by Mr. C. C. Martin, of Kansas City, Mo., who is shown here signaling in the general service code to a neighbor.

© International Film Service

Motoring Up the Steps of Boston's Capitol

MANY of the daring heroes and heroines of fiction are credited with riding their steeds up the steps of some dignified old building; it took a theatrical hero to ride up steps in an automobile. His name is Harold Du Kane, and he rode his automobile up the steps of the Capitol at Boston.

We show him just starting up, while a startled staid Bostonian has turned to gape after him. Harold Du Kane, by the way, is an expert stage dancer.

Where does he come from? His car bears a New York license. Did he motor to Boston just to do this stunt?

How to Make a Wrist-Watch Stay Put

TO the hunter or traveler it is useful to know the time accurately, and most important to know direction. Watch or compass stand the chance of being lost, and the lack cannot be remedied in the wilds. So camper and woodsman are taking a leaf out of the book of the soldier.

The world war made the wrist-watch acceptable to male society and the soldiers found a patented lock, like the one pictured above, useful.

The clasp is fastened by a small sliding bar which locks two small round extensions on the under part in two holes of corresponding size in the upper part.

Thimble, Thimble, Who's Got the Thimble?

"OH, there's a mouse!" Don't get agitated, dear lady, and never mind if the cat is on vacation and there's no mouse-trap at hand. Just slip off your thimble, and get a plate, and a bowl small enough to fit inside the plate, mouth down. Fill the thimble with such food as your observation or instinct tells you mice like best, then place the bowl upside down on the plate, supporting one edge of the bowl on the thimble, which should be placed open end in.

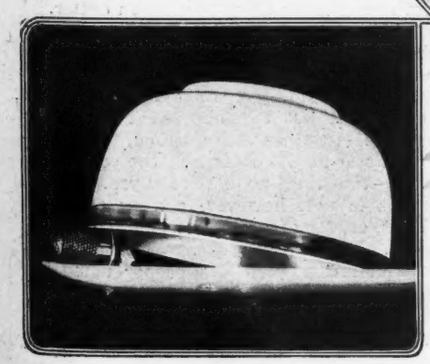
The mouse enters, smells the food, crawls under the raised edge of bowl, and begins to nibble. Down comes the bowl, taking the mouse prisoner.

Blowing Old Trees Down with Dynamite

"WOODMAN, spare that tree!" and all the touching phrases that follow were written by George Morris in 1830. 'Tis fortunate that he didn't appear upon the scene a hundred years later, for he might then have had to say, "Engineer, don't light that fuse!" which is not nearly so effective.

The woodman and his ax are giving way to the engineer and his dynamite, for dynamite works much more easily and quickly than does the ax. You tie dynamite around the tree-trunk, as the picture shows, then attach a fuse to it and set it off. Down comes the tree. Simple, isn't it?

© Press Illustrating Service



Japan's Football Costume

AS long as the tight skirt fad doesn't spread to Japan, the Japanese will be able to enjoy their football games. What have tight skirts got to do with football? Plenty; football is played only by members of the nobility, and they wear skirts.

How could this noble Japanese kick the ball if his skirt were any tighter?

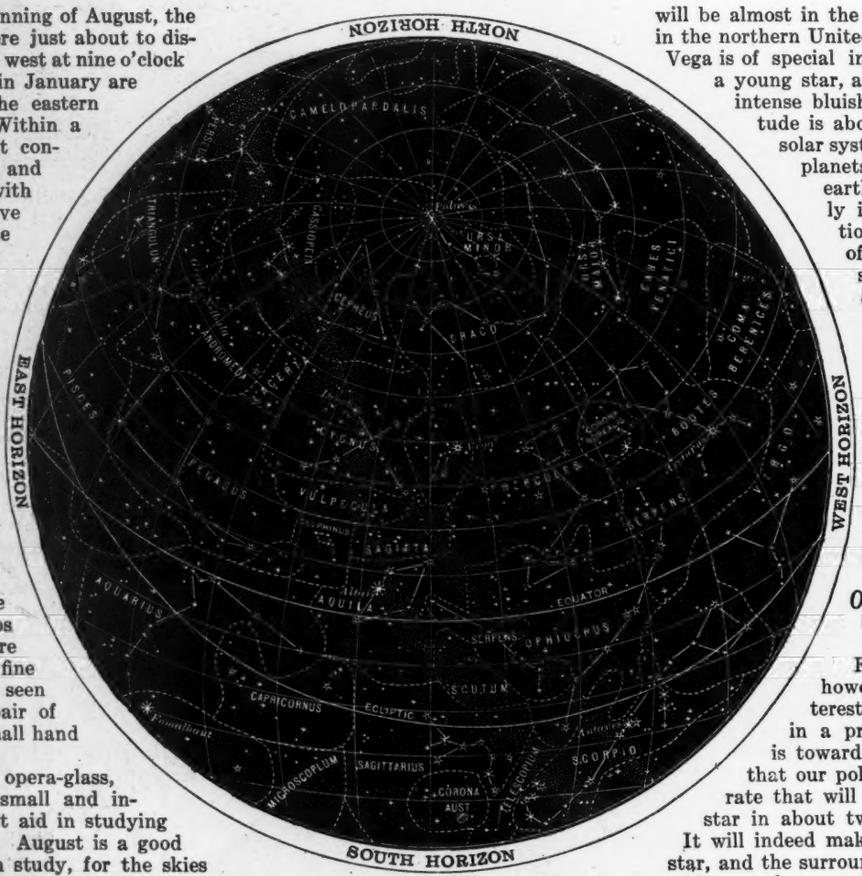
Finding Your Way Among the August Stars

We are now ready, with the help of a pair of opera-glasses, to study the individual stars

By Ernest A. Hodgson

WITH the beginning of August, the stars that were just about to disappear in the west at nine o'clock in the early evening in January are now just rising in the eastern sky at that time. Within a few months the great constellations of Orion and Taurus will again be with us. Those who have been following these articles since they began will have completed a round of the heavens. They will have seen the stars rising and setting daily, but at the same time moving nearer the west each evening. The relative positions of the constellations should be now more or less familiar, and those who are following the changing sky groups will wish to know more of the particularly fine objects that can be seen with the aid of a pair of opera-glasses or a small hand telescope.

A telescope or opera-glass, even though it be small and inexpensive, is of great aid in studying the individual stars. August is a good month to begin such study, for the skies are often clear in the fall, and from then on the groups become finer and finer, until in January they make the best showing of all the year. It is proposed to take a single constellation and give an enlarged map of it each month, indicating the objects that are most worthy of study in that constellation, and at the same time giving the various letters and numbers used to designate the brighter stars in the group. If that one constellation is taken as an object of special study during that month, the stars within it will gradually become known by name and the objects of interest become our familiar friends.



The Star Map for August

This map represents the appearance of the sky at the times listed below. It is specifically arranged for the latitude of New York, 40° north, but is practical for ten degrees on either side of this latitude.

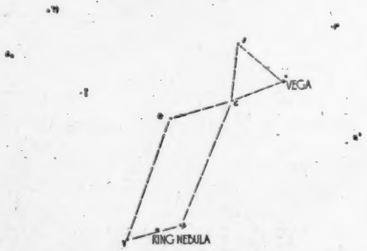
July 8, Midnight	Aug. 7, 10 P. M.	Sept. 6, 8 P. M.
July 15, 11.30 P. M.	Aug. 15, 9.30 P. M.	Sept. 14, 7.30 P. M.
July 23, 11 P. M.	Aug. 22, 9 P. M.	Sept. 22, 7 P. M.
July 30, 10.30 P. M.	Aug. 30, 8.30 P. M.	Sept. 29, 6.30 P. M.

The magnitudes are indicated on the map by stars of various kinds as follows: 0, open center; 1, eight points; 2, six points; 3, five points; 4, four points; 5 is indicated by a single point. Eastern Standard Time.

Lyra—Constellation of the Harp

One of the smallest of the constellations, but one containing very many objects worthy of special attention, is that of Lyra—the constellation of the harp. As it is now well up to the meridian at nine o'clock in the evening, it may be chosen as our first subject for special investigation.

The constellation may be located readily, for at nine o'clock, in the middle of August, the brightest star, Vega, or Alpha Lyrae, will be almost in the zenith for observers in the northern United States.



Vega, the brightest star in the constellation Lyra (the harp), is an intense bluish white; it is almost at its zenith in the middle of August

Vega is of special interest to us. It is a young star, as stars go, and is an intense bluish white. Its magnitude is about zero. Our whole solar system—the sun and the planets, including our own earth—are moving bodily in the general direction of Vega at a rate of about ten miles a second. In about 558,000 years we shall be occupying the position in space at present held by Vega; but in the meantime it will have moved aside, and we shall then be almost as far away from it as we are at present—that is, about thirty-five light-years.

Our Pole-Star in Twelve Thousand Years

For another reason, however, Vega is of interest, as was pointed out in a previous article; for it is toward the position of Vega that our pole is passing, and at a rate that will make Vega our pole-star in about twelve thousand years. It will indeed make a magnificent pole-star, and the surrounding bright stars will add greatly to the beauty of the heavens.

Vega, together with Zeta and Epsilon, form an equilateral triangle. Epsilon is the famous "double, double." An opera-glass will serve to show it double; a small telescope will show each component also double—four companions where only one can be seen with the naked eye. They are to be grouped two and two, for it is found that two of them move about a common center, as do our sun and the various planets. This is true of the other pair, and the probability is that both pairs move about a common center.

Beta, at the lower right-hand corner of the parallelogram, is a variable star of a period of about thirteen days. It varies from magnitude 4.1 to magnitude 3.4. It is of interest too, because it serves to indicate—together with Gamma, the other bright star at the bottom of the parallelogram—the ring nebula of Lyra. This nebula is not, however, a very striking object, as, for example, the one in Andromeda. It is invisible except with a telescope of fair power. Its proper name is Messier 57, so called because it is listed as number 57 in a catalogue of nebulae by Messier.

The Planets for August

DURING the month all of the brighter planets will be clustered so closely about the sun that it will be impossible to see all of them. Mercury is retrograding up to the 24th, when it becomes stationary. On the 15th it is in conjunction with the sun, and at no time during the month is it far enough away from that body to be visible.

Venus is an evening star, but is not to be so much longer. It is only about two hours and a half east of the sun at the first of the month, and on the 20th it becomes stationary. It then begins to retrograde, coming nearer and nearer the sun until at the last of the month it is only about an hour to the east of it. Within a short time it will have moved so near to the sun that it will be invisible, emerging later to the west of the sun and becoming a morning star.

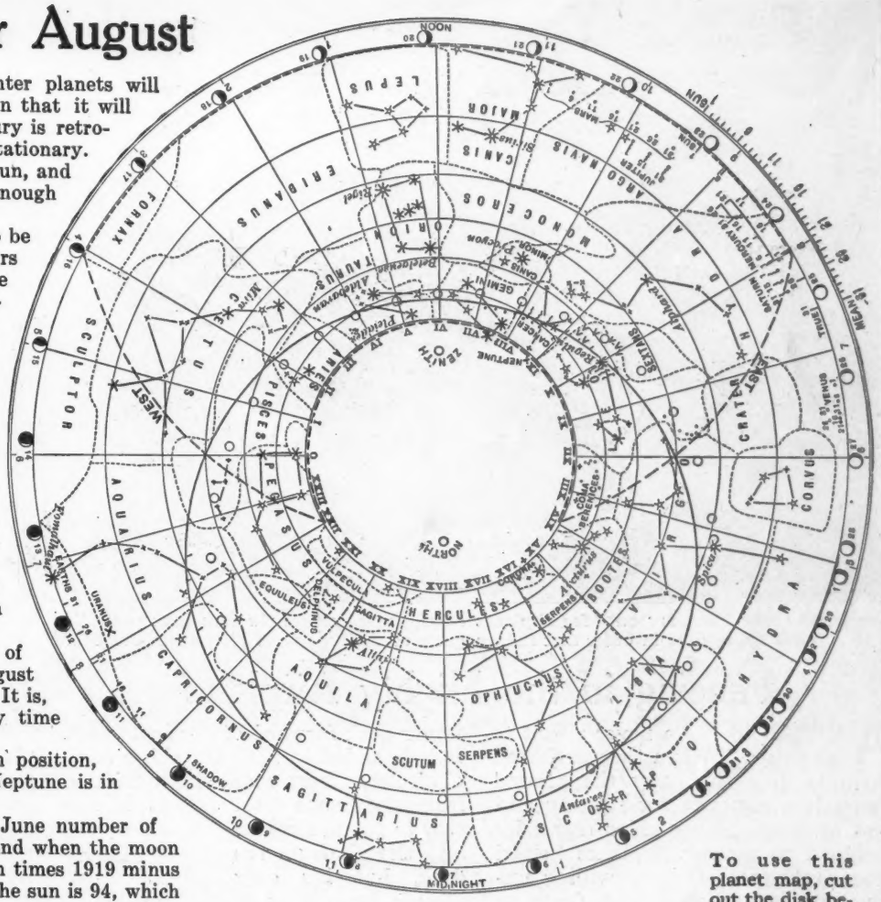
Mars is a morning star, rising shortly before the sun. It will be so close during the month that it will be barely visible in the glow of sunrise.

Jupiter has also become a morning star, and is even closer to the sun than is Mars.

Saturn begins the month to the east of the sun. It is in conjunction on August 25, and rises thereafter before the sun. It is, however, too close to be seen at any time during the month.

Uranus and Neptune are indicated in position, but are invisible to the naked eye. Neptune is in conjunction with the sun on August 1.

Testing out the rule given in the June number of POPULAR SCIENCE MONTHLY, we shall find when the moon is to be full. The year number is eleven times 1919 minus 1911, or 88. The month number is 6. The sun is 94, which leaves a balance of 4 after taking away as many thirties as possible. To make the moon full—fifteen days old—eleven more days are required. Hence it will be full on the 11th of August, a fact that may be verified by reference to any almanac.



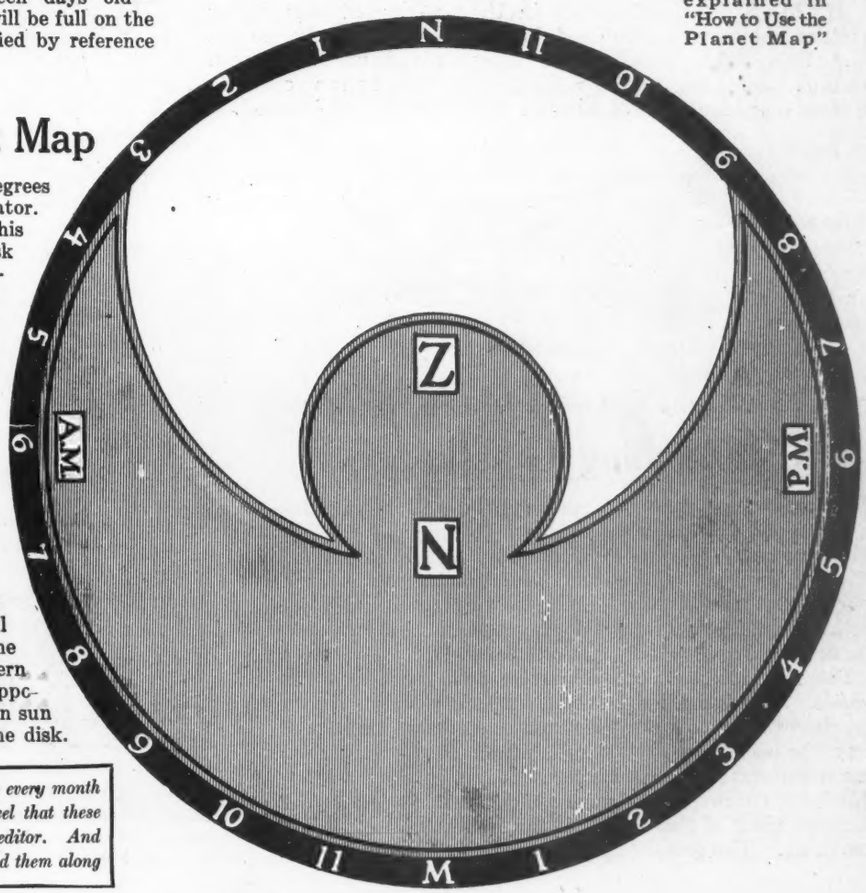
To use this planet map, cut out the disk below and use it as explained in "How to Use the Planet Map"

How to Use the Planet Map

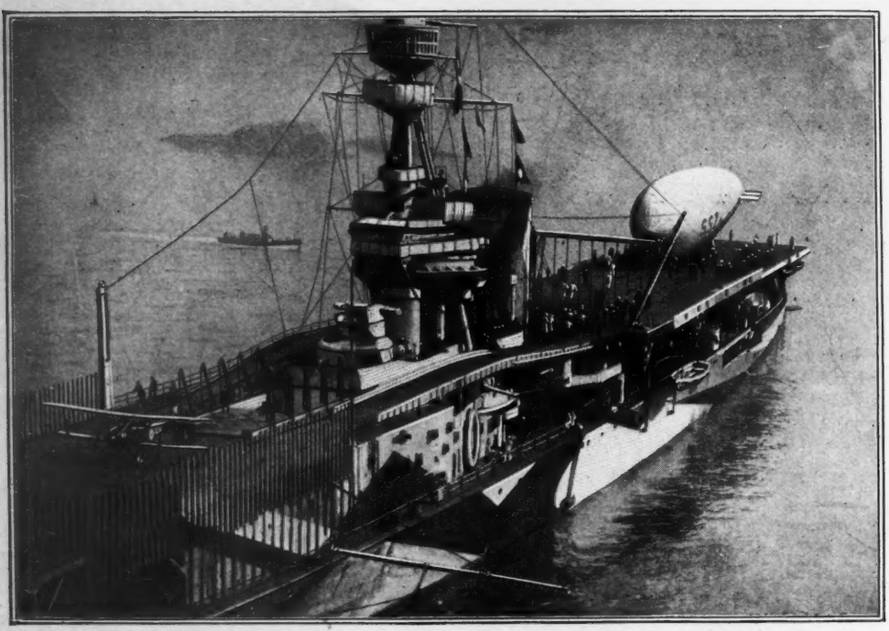
THE planet map indicates a belt 30 degrees wide on each side of the celestial equator. To use it, cut out the circular disk on this page and mount on a thin cardboard disk of the same size. Then run a glass-headed push-pin through the center of both the disk and the map.

To see the section of sky visible at any hour of any day in the month, turn the disk until the required hour is opposite the required date on the chart line of the mean sun. Now, keeping the disk fixed with respect to the map, turn both until the opening is at the bottom as you hold the map before you. Turn to the south, and the stars will be readily picked up by glancing up from map to sky. The planets can then be determined.

To find when any given star or planet will rise, transit, or set, turn the disk until the body is on the eastern horizon, in the center of the cut-out, or on the western horizon, as the case may be. Look opposite the date on the chart line of the mean sun and read off the time on the edge of the disk.



The POPULAR SCIENCE MONTHLY *is publishing every month an article like this by Mr. Hodgson. If you feel that these articles can be made more helpful, write to the editor. And if there are questions you would like to ask send them along*

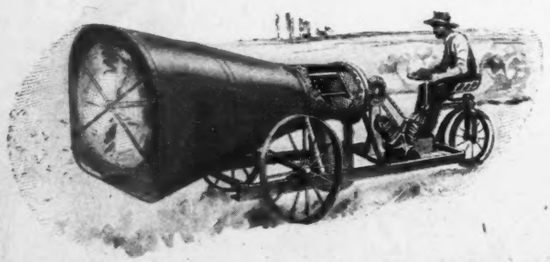


Over the fence is "out" for airplanes on shipboard, where they are kept penned in until flying time in order that sudden gusts of wind may not blow them overboard

Fencing in the Flighty Airplane

AIRPLANES were never meant to go to sea. When the war forced them to join the navy they found themselves cramped for starting and landing room. Then ships especially designed to mother airplanes helped to solve the problem by providing unusually long and wide flush decks as marine aviation fields.

H. M. S. *Furious*, shown in the picture above, is a combined hangar and flying-field. One of the most curious bits of her special equipment is the high fence built around her upper deck forward of her lone mast. It is intended to keep the ship's flock of airplanes from wandering unbidden from the home pasture. It is not easy to get an airplane into the air from the deck, but it's easy enough for a gust of wind to slip under the wings of one idling on deck and urge the airplane overboard. The fence can be raised and lowered.



This peculiar-looking machine harvests grasshoppers by the wholesale

He's Catching Grasshoppers

ON a hot night in the country you will hear grasshoppers singing in the bushes. In the day-time they are comparatively quiet. What does this quiet mean? Mischief, as usual. They are out eating up the farmers' crops. But the days of their feasting are numbered, for Mr. Samuel H. Pierce, of Dayton, Ohio, has invented a machine for harvesting grasshoppers.

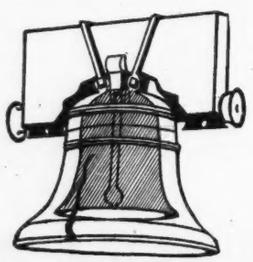
The machine looks like an overgrown megaphone on wheels. The funnel is of metal, and has a motor-driven fan close to its mouth. This creates sufficient suction to draw the insects into the funnel, where they are gathered into a perforated chamber and thence drop into a removable box. A revolving brush keeps the air-holes in the chamber clear of the bodies of the insects and insures a free draft. The grasshoppers are fed to chickens.

Shall the Liberty Bell Ring Out Once More?

SHALL the Liberty Bell ring out once more? Ever since 1843 it has remained mute—and for good reason. When it was being rung on February 22, 1843, the crack in it, which had appeared some eight years before, so increased as nearly to destroy its sound. Ever since that time it has silently held its post at the head of the stairway in Independence Hall in Philadelphia, where it has received the reverential inspection of thousands of Americans.

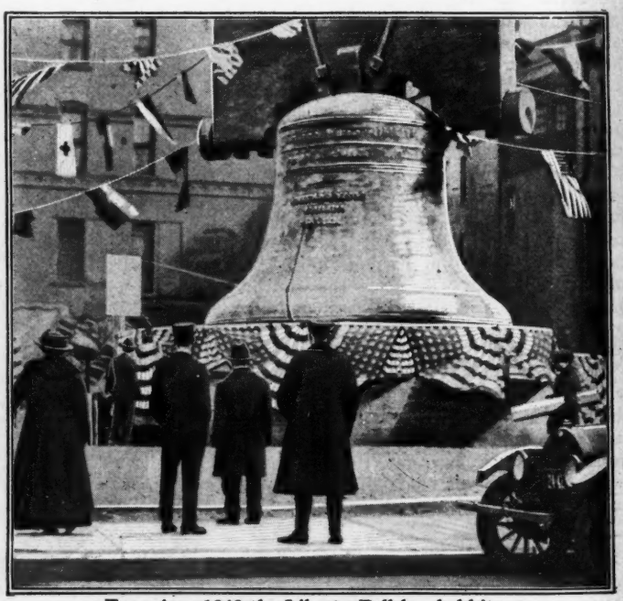
The original bell was cast in England in 1752, and was cracked soon after it was brought to America. It was recast in Philadelphia, more copper being put into its composition. But it cracked again while being tolled in memory of Chief Justice John Marshall in 1835; and the crack extended, as has been said, in 1843.

Here is a suggestion. Why not place within the Liberty Bell a second smaller bell which can be rung? The proportions of the original bell permit of this, and it will be, in fact, a cover or jacket for the sound-giving bell.



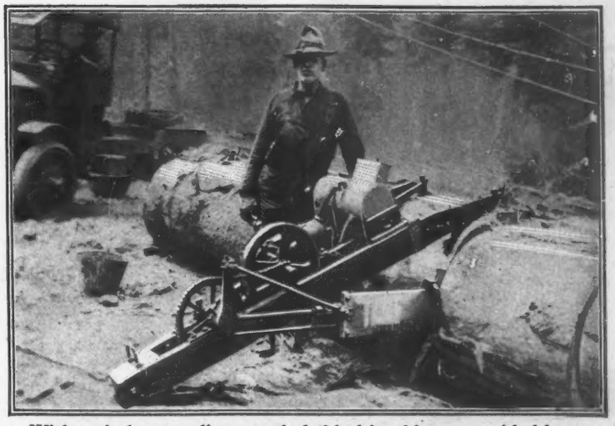
A smaller bell inside of the Liberty Bell could be rung

Surely this generation ought to see the historic bell swinging once more as joyous peals "Proclaim Liberty Throughout All the Land Unto All the Inhabitants Thereof," as the inscription on the bell reads.



Ever since 1843 the Liberty Bell has held its place in Independence Hall in Philadelphia

Sawing with Gasoline



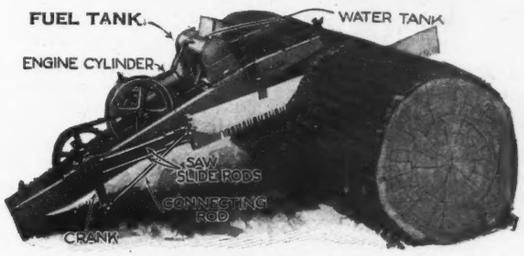
With a tireless gasoline muscle behind it, this saw, guided by one man, will do the work ordinarily accomplished by ten men

IF you were raised on a farm, you will remember the back-breaking job that was your share every fall when you had to work the cross-cut saw to get in the winter's supply of wood.

Cutting up the larger trees was a slow, tedious task. The progressive present-day farmer has relegated the hand cross-cut saw to the scrap-heap and substituted the mechanical cross-cut saw. The same type of saw may also be found in practically all of the lumber camps for sawing up the larger trees.

The mechanical saw will cut as much cord wood in any given time as ten men. It requires only one man to operate it, and costs less than three cents a cord for fuel and upkeep expense.

The apparatus of this mechanical saw consists of a V-shaped frame, a small gasoline engine, and a saw oscillated by power from the engine. The framework is laid on top of the log, with the open ends of the V on the log and the point of the V on the ground, thus providing a three-point support which makes it possible to adjust the frame on any log, no matter what its position on the ground. The open ends of the V framework are provided with sharp steel dogs, which are driven into the log to hold the frame in place.



The gasoline-driven saw consists of a V-shaped frame, a small gasoline engine, and a saw

The engine is a four-horse-power, two-cycle, water-cooled type with the cylinder laid parallel with the length of the arms. The fuel- and water-tanks are mounted across the arms of the frame-work above the engine, so that the fuel feeds by the force of gravity.

The saw itself is located on one side of the frame, and is driven by means of a crank arm mounted on a shaft that revolves by means of a chain and sprocket about the gasoline engine-shaft.

One end of the saw is free and the other is carried on a pair of guide rods, in addition to the driving crank arm and a connecting rod attached to the end of the saw. The movement of this connecting-rod, as caused by the revolution of the power crank arm, causes the saw to oscillate sufficiently to clear the sawdust out of the cut on each stroke, so that the blade moves back and forth freely.

The entire apparatus is light in weight and can be moved from point to point by two men.

Ever Hear of a Drill that Will Bore Square Holes?

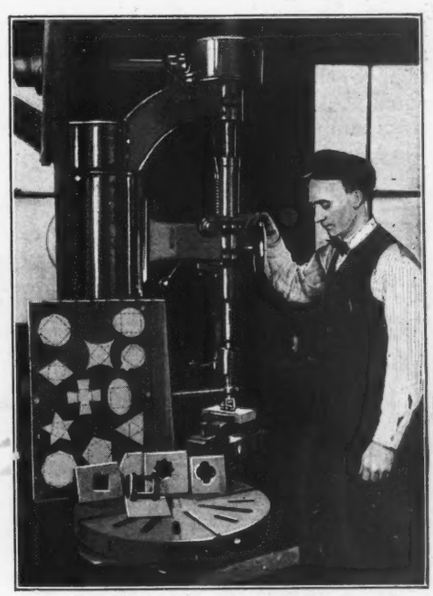
PROBABLY you've heard of someone dreaming of a machine that would drill square holes, because for years the invention of such a tool has been the dream of mechanical engineers; but it remained for Carl H. Schmidgall, who runs a shop in Peoria, Ill., to invent a square-hole auger. And this invention not only bores square holes in wood, but will bore through iron and stone as well.

Schmidgall's invention is the result of twelve years of work, and is a marvel of mechanical simplicity. Six days after receiving his patent on it, March 24, 1919, his new invention was declared by one of the largest universities in the United States to be a practical, simple, and durable machine of sound design.

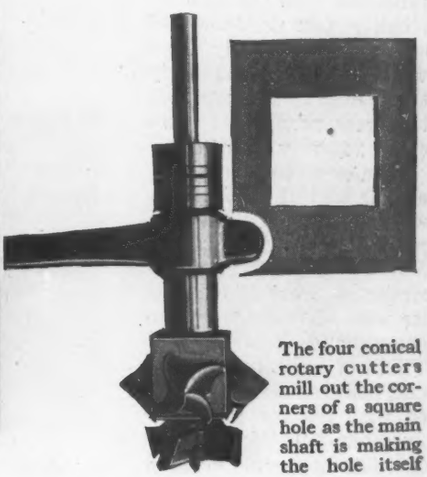
Not only does Schmidgall's new invention bore square holes, but by slight variations in the cutters it will bore holes of almost any shape—octagons, ovals, key-holes, and many-sided and irregular holes.

The little machine really is five augers in one, four conical rotary cutters milling out the corners of the square hole as the main shaft sinks a hole through the wood. In boring through iron or stone two operations are necessary: first a round hole is drilled through, and then the four rotary cutters mill out the corners in a single operation.

Four hours or more of careful work is necessary, under present methods, to drill a square hole through a one-inch piece of marble. By the new invention it can be done in five minutes.



Boring square holes, or any shape you wish. The machine and some of its work



The four conical rotary cutters mill out the corners of a square hole as the main shaft is making the hole itself

Across the Atlantic in a Single Jump

By Waldemar Kaempffert

The Vimy-Vickers machine in which Alcock and Brown crossed the Atlantic is much larger than either the Sopwith or the Martinsyde airplanes. It carries two Rolls-Royce engines of 350-horsepower each. The fuselage, or hull, is forty-three feet in length; the wing span from tip to tip is sixty-eight feet. The gasoline was contained in nine tanks, which were emptied one after another. The largest of these, a seventy-gallon tank, was fitted with life-lines, so that it could be used as a float if the machine fell into the sea, being released by removing two clips. It could have sustained the weight of the two flyers. All told, eight hundred and seventy gallons of fuel was carried in the tanks. Distributed as it was, the gasoline could not wash from side to side in a large mass. Fully loaded the machine weighed fourteen thousand pounds

"CAN it be done?"

Never again will that question be asked when the subject of flying across the Atlantic in a single leap comes up.

There were good reasons to doubt the feasibility of the flight. Had it not been proved by theorists, with their ever-ready pencils, that the maximum range of the airplane is twelve hundred miles? The problem of flying across in one stage resolved itself into one of providing fuel-carrying capacity.

A Battle with the Elements

The speed at which the crossing was made (sixteen hours and twelve minutes) was due largely to the favorable following winds that prevailed. Much of the journey was made at a height of more than a mile, and some of it at even more than two miles. Above ten thousand feet, the meteorologists tell us, the wind sweeps continuously from west to east. Evidently the Vimy-Vickers entered the great, permanent planetary westerly swirl.

As meteorologists expected, the cold at that height was intense. Think of a machine covered with sleet! Think of Brown unstrapping himself to chip ice with his knife from the gages and instruments! Think of radiator shutters and thermometers encrusted with ice for four and five hours! Think of an airspeed indicator so clogged with ice that it refused to work! Is there no romance in flying across the ocean? Clearly, the clippers of the air will wing their way to England, not in a dull, mechanical way, but in battling at great heights with the elements.

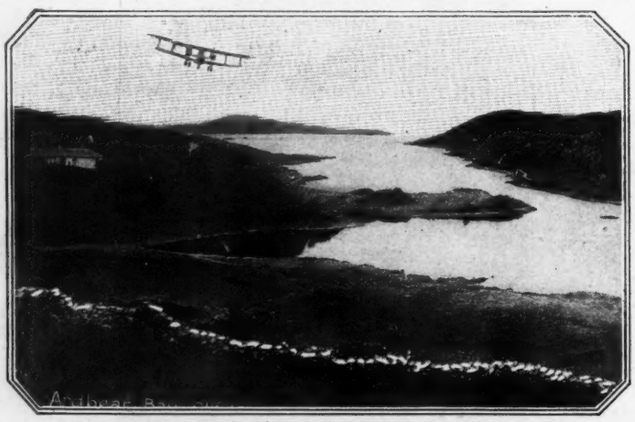
The experiences of the Vimy-Vickers are curiously like the experiences of the American NC planes. Towers and Read, as well as Captain Alcock, found it utterly impossible to get their bearings in the fog. Says Alcock: "We scarcely saw the sun or the moon or the stars; for hours we saw none of them."

With the radio direction-finder out of order, with only a compass to guide them (and the compass tells nothing of the machine's drift in the wind), what agonies of doubt they must have suffered! It was the providential appearance of the sun that saved Read on the trip to the Azores, and it was an equally providential glimpse of the stars that enabled Brown to determine his position and to bring the craft back to its course.

The flight of Alcock and Brown was meteorologically unthinkable before the war. In 1912 a pilot would toss a handful of torn tissue paper into the air, and if the wind was too strong he would not go up. Alcock and Brown set off in the teeth of a gale.

Fog—the Aviator's Dread

All this speaks volumes for the engines. Alcock did not use the full power of his engines. "I never opened the throttle once," he assures us—meaning, of course, that he never opened it to the full. Nevertheless, the Vimy had an absolute speed of ninety miles an hour. Aided by a following wind, she averaged one hundred and twenty for the voyage. That record is not likely to be lowered for some time.



Ardbear Bay, near the Clifden wireless station, where Captain Alcock landed. If Lisbon is the San Salvador of flying, Ardbear Bay must be the Plymouth Rock

Fog has always been the aviator's dread. It destroys a pilot's sense of verticality. Alcock believes that for a time he was flying upside down. Other pilots have had that experience. To be sure, it cannot last long. Stand on your head for five minutes and you will be aware of your position simply because of the rush of blood to your brain.

"We looped the loop, I do believe," Alcock tells us, "and did a very steep spiral. We did some very comic stunts, for I had no sense of the horizon." It

may be doubted if he looped the loop in a machine so heavily burdened.

As it was, Brown was able to take only four readings: one from the sun, one from the moon, one from the pole-star, and one from the star Vega. That Captain Alcock actually did fly upside-down for a brief moment or two is not a mere supposition on his part. It happened near the water, after a drop from four thousand feet. As soon as he saw the waves he realized his predicament and shot up again. "That period lasted only a few seconds, but it seemed ages," to use his own words. "It came to an end when we were within fifty feet of the water with the machine practically on its back."

Not for the Land Machine

The flight of Alcock repeats the lesson taught by the NC planes: Clouds combined with thick weather and rain render it impracticable to follow the land practice of flying at an altitude of from four to five thousand feet. The pilot must either climb very high in order to locate his position by the stars or the sun, observations which are at best only a rough guide, because of the aircraft's tremendous speed; or he must fly near enough to the surface of the water to see very clearly the direction he is pursuing with reference to the waves.

There is no vital objection to flying low. The sea air at low elevations is steady, and alighting in a flying-boat becomes possible at any time. Indeed, there is a certain advantage in flying low, because the air near the surface has greater supporting power. The one reason for flying very high (ten thousand feet or more) would be to take advantage of the westerly winds that always blow aloft. But this counts for little with machines that are faster than either the Sopwith that Hawker used or the Vimy-Vickers that Alcock piloted so successfully.

Captain Alcock reinforces the POPULAR SCIENCE MONTHLY'S conclusion that transatlantic flying is not for the land machine. "The flight has shown that the Atlantic flight is practicable. It should be done, not with an airplane or a seaplane, but with a flying-boat."

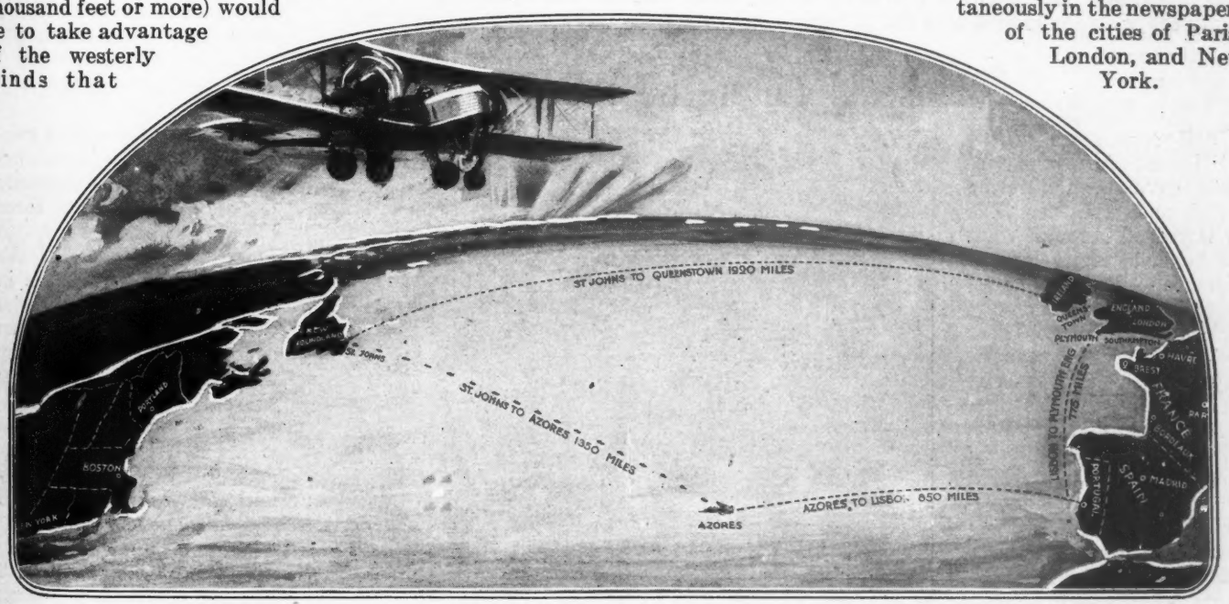
The men who made the big jump. Captain John Alcock, wearing a soft hat and a smile, was "Jack" to everybody at Brooklands, London's flying center. He has been an aviator since 1912. Lieutenant Arthur W. Brown (in uniform), although in the British service, is an American. Mechanics has been his passion since boyhood

In commenting on the lessons taught by the American transatlantic voyage, the POPULAR SCIENCE MONTHLY, in its July issue, pointed out the need for more efficient radio apparatus to assist the transatlantic flyer. The truth is that radio-communication has proved a lamentable failure in every transatlantic flight thus far made. Alcock tells us that the little wind-driven propeller, by which his generator was driven, blew off. Surely there is need of an independent motor driven radio set—something that can be relied upon when the craft is in the air as well as when it rests on the water. It may be urged that the additional weight required militates against such an apparatus. Let it be remembered that Alcock landed in Ireland with only two thirds of his fuel consumed. It is evident that the carrying capacity of even a bomb-dropping plane of the Vickers type would not be strained beyond the maximum if an independently driven radio set were provided.

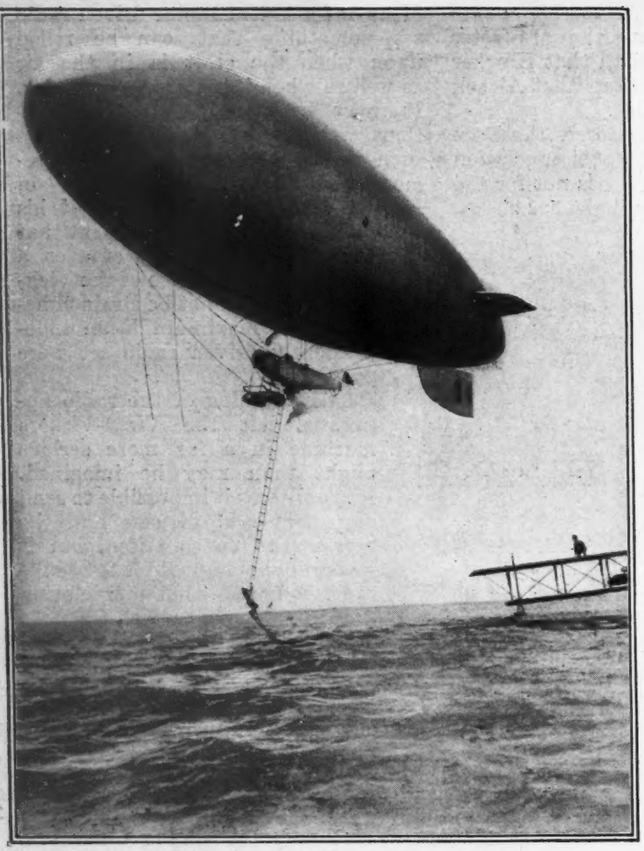
The crippling of the radio apparatus left the Vimy-Vickers machine in a far more serious plight than may be imagined. Not only was it impossible to send any signals of distress had the occasion to do so arisen, but it was probably impossible to use the radio compass—that marvelously simple instrument which has been described in the POPULAR SCIENCE MONTHLY, and by means of which the navigator in the densest fog or the blackest night can determine his position by reference to some powerful radio stations on land or on sea.

Advantages Over the Cable

There is more than may be supposed in Lord Northcliffe's prediction that some day the newspapers of London will be selling on the streets of New York on the same day of their publication. In a sense, the day of the international newspaper has dawned. What anxious moments would have been spared us during the peace conferences in Paris if full accounts of the proceedings had appeared simultaneously in the newspapers of the cities of Paris, London, and New York.



Comparing the "one-jump" route taken by Captain Alcock with that by way of the Azores followed by the NC flying-boats, we see at once that the Azores route will be the choice of the transatlantic air-liners of the future. Fewer miles to fly means less weight to carry, and less weight of fuel means more paying freight



The blimp has answered the "first-aid" call of a seaplane, and is taking the aviators on board

A Blimp to the Rescue

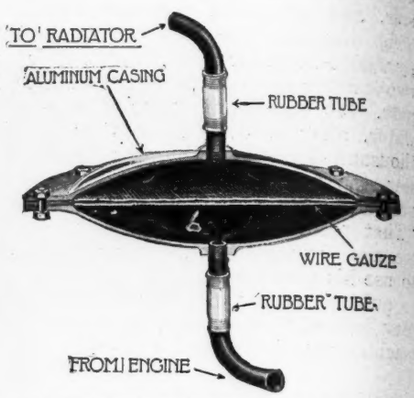
EVEN the powerful NC-3 was battered up when she was forced to land in a rough sea. Consequently our navy fully realizes that it must keep a watchful eye on venturesome ocean-going seaplanes.

Blimps are now being taught to rescue aviators from seaplanes. The blimp approaches a seaplane until it is just overhead. Then it turns around until it is heading directly into the wind. This makes it practically stationary. The blimp drops a rope ladder, and the aviators climb up.

Grit in the Radiator

A tremendous trifle in a transatlantic flight

DO you remember the early days of the automobile, when you were never certain that your "horseless carriage" would run for a hundred miles without a breakdown? The airplane of today is in about the same stage of development. Stinginess characterizes the construction of minor parts. Hawker failed to cross the Atlantic because of this stinginess in small things.



If Hawker's engine had been equipped with a filter such as this, he might have been the first over the "big jump"

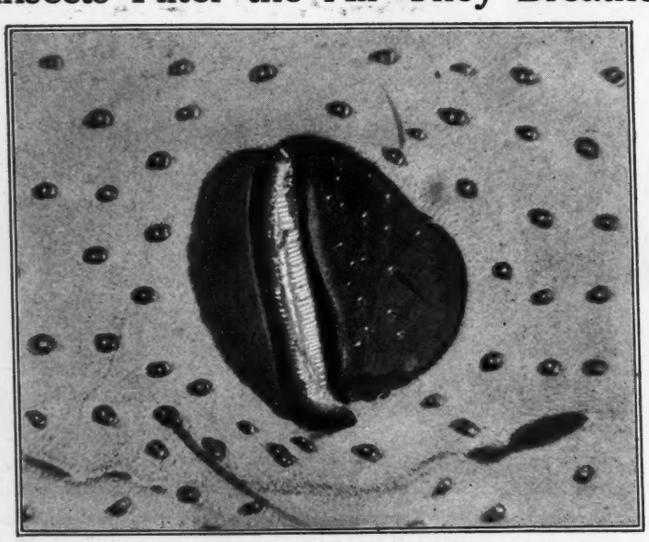
One would have supposed that, with the assistance of one of the best airplane engines of today, Hawker would not be compelled to report that dirt was shaken loose within his radiator by prolonged vibration, to choke up the water-filter of the circulation pump. Why should this be so? How much would be added to the total weight of a three-hundred-horsepower engine if that filter were made so large that even a handful of sand thrown into the circulation system would still leave sufficient filtering surface to produce the desired effect?

Why should these trifles be left eternally to chance? Why not let the water pass through within a large flat chamber across which is stretched at least a square foot of fine wire meshing in a double layer? There is no reason why this box should not be made absolutely tight. For tubes, use rubber, which is easily renewed.

The only real obstacle to the abandonment of the trifles that caused Hawker's descent is to be found in a certain vanity of manufacturers. They do not want so-called clumsy contrivances. They will not admit that grit enough can ever find its way into the water circulation to stop a transatlantic flight.

Insects Filter the Air They Breathe

FOR eons some of the lowest forms of insects have been filtering the air they breathe. The air is passed through what are called spiracles or stigmata — little openings, usually in two rows, one on each side of the body. These openings may be seen as tiny spots in many insects, without even the use of a pocket magnifier; but it is only under the compound microscope (through which the accompanying illustration of a spiracle of a water-beetle was photographed) that the sievelike arrangements may be seen. Particles of dust, which would otherwise enter the air-passages, are filtered out.



This is but one of the openings through which a water-beetle breathes; each is provided with a sievelike arrangement

In the larvae of the two-winged fly, the breathing-tube at the end of the body can be lengthened to three inches, if necessary, to reach the surface of the water. The air rushes in and out of the spiracles about as it does in an accordion. It is not easy to drown an insect, because there is always a considerable supply of air within the tracheae—the tubes that extend through the body and that are connected with the spiracle openings.

When a housekeeper attempts to kill flies with powder, she does her work by clogging or obstructing the spiracles. Sometimes the flies revive.

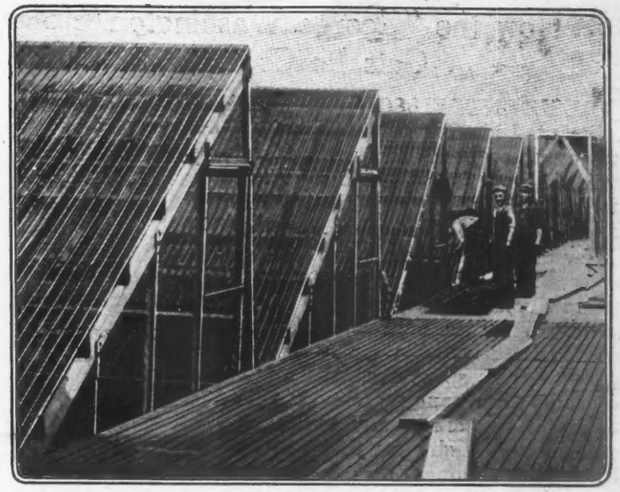
Something New in Windows

By F. W. Fitzpatrick

UNLIKE the old-time gloomy small-windowed workshops, a modern factory is nearly all glass. There are brick or concrete piers just large enough to furnish the support for the structure, and, in the spaces between the outer piers, huge windows with tiny steel divisions.

But in certain exposures these windows have to be curtained for hours every day. Direct sunlight, especially when it is from the west, is persistent, very intense, and dazzling. Without curtains one cannot work within fifteen feet of the windows; and even beyond that point the glare and reflection are trying. In some lines of work they are positively dangerous. Yet, with curtains or shades opaque enough to keep out this glare of the direct sun, the interior of the shop is darkened. It's a case of being uncomfortable either way.

The "saw-tooth" skylight that is so common in factories today suggests a remedy for this. Indeed, one might tilt such a skylight up edgewise and use it as a window.

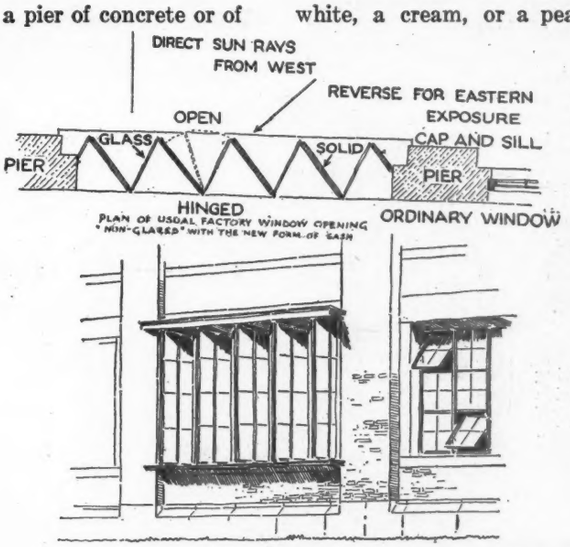


Why not make windows like skylights? Have one side fixed and the other side swinging, thus preventing glare but admitting air

The plan illustrated here shows a pier of concrete or of brick. On the right is the usual window plan, but on the left is seen the suggested new arrangement. The vertical panels, louvres, or sections are solid and set at right angles to due west or to due east.

These panels are fixed rigidly from the sill to the window-cap. The greater the distance they project beyond the outside line of wall, naturally, the more light will come in the room.

These sections can be of metal, slate, wood, or any other solid. Their outside surfaces should be dark, either black or gray, so as not to throw troublesome reflections upon other buildings. The inside surfaces should be light, but not a dazzling white, a cream, or a pearl gray. The glazed sashes are set vertically and hinged at their juncture with the solid panels.



Comparing the old-fashioned with the new-fashioned window opening. The latter introduces infinitely more light and air into the building and does away with sun glare

These sashes are not arranged at right angles to the solid panels, but are set so as to deflect the rays of light against these surfaces. They are arranged so that the whole of the glazed surface offers a radiance of the same angle without overlapping. In other words, there are no dark points, as there would be if the sash-bar intervened.

These windows can be introduced anywhere without necessitating any structural change. They would fill the ordinary opening provided for any other window. Each glass sash is hinged on one side.

Teaching the young idea how to shoot. Incidentally we may develop a future billiard champion

Now for a Boy Hoppé or de Oro

BILLIARDS and pool have long ceased to be the monopoly of mere man. Women have taken them up, and now even the children have an opportunity to amuse themselves with these fascinating pastimes and to acquire skill and dexterity in "handling the ivories."

A combination billiard and pool table, only eighteen inches by twenty-four inches in size, has recently been placed in the market. The balls are not much larger than average marbles, and both carom and pool sets are supplied with each table.

The cues differ from those that are used in playing on full-sized tables. They consist of a tube in which a piston slides back and forth. The piston is propelled forward for the stroke by pressing a pneumatic bulb. With this pneumatic cue considerable skill can be developed. The change from a billiard to a pool table can be made quickly, and a rack at one end of the table provides a place for the balls that have been pocketed.

How the "George Washington" Gets Its Coal

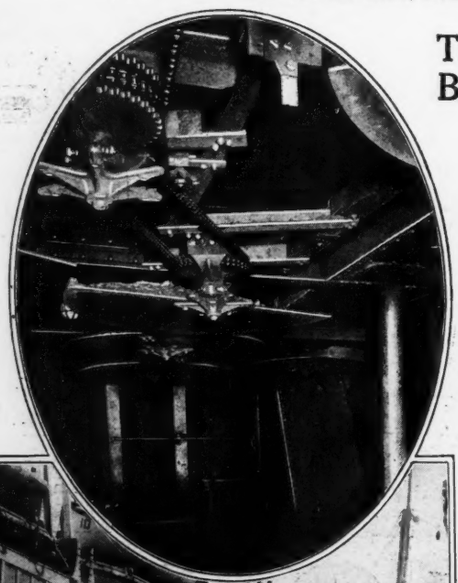
PRESIDENT WILSON wirelessed from France that he wanted his *George Washington*. In a very short time long black coal-elevators were crawling up her side and feeding her coal for the trip at the astonishing rate of one hundred and twenty-five tons an hour; and soon she was all ready to start.

How do these elevators work so fast? The coal on the barges below is fed automatically into buckets on an endless chain in the elevator, which revolves by means of a motor. When the buckets reach the ports they discharge their coal into chutes, and then continue up and over the top. This saves breakage and flying coal-dust, and maintains a continuous stream of coal.

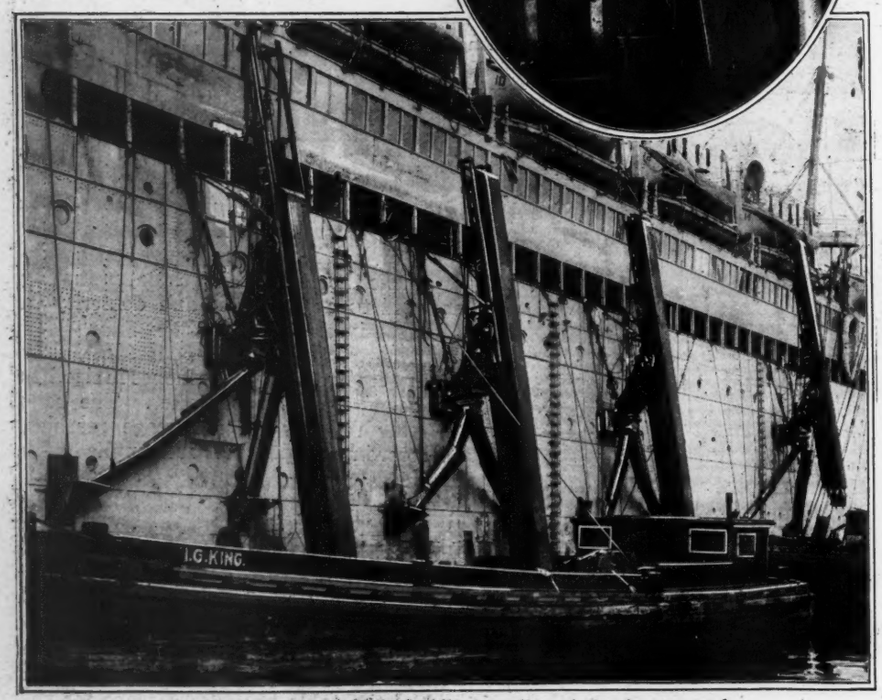
The elevators are usually hoisted into position on the offshore side of the ship, so that coaling in no way interferes with cargo-handling. Since the machine weighs thirteen thousand pounds, it is hoisted into place at the ship's side either by a boom on the pier or ship, or by a floating derrick alongside.

This huge machine is held in place by tackle attached to the deck. When a barge of coal is brought up, the elevator is lifted slightly and the motor is started. Then, when it is lowered into the coal, the buckets are revolving and they immediately start scooping the coal up.

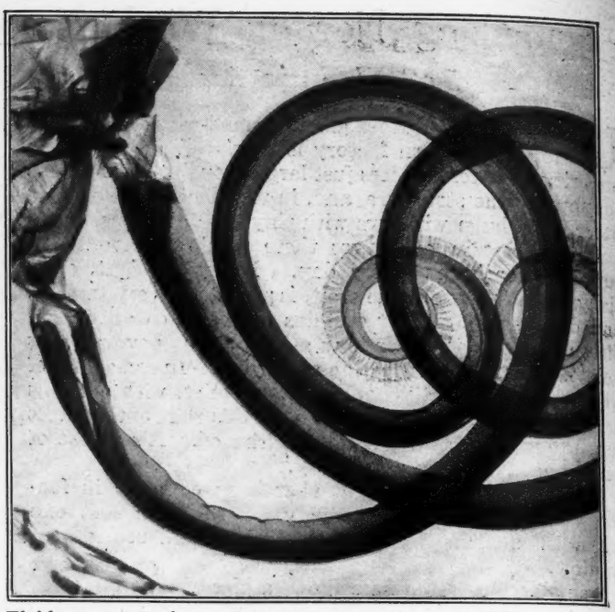
When the coal enters the portholes through one or more chutes, it lands on revolving disks which are fitted with plows that scoop the coal off and drop it on adjacent disks. In this way the coal is carried to the farthest corners of the bunkers.



The coal lands on revolving disks which are fitted with plows that scoop the coal off and drop it on adjacent disks. Thus the coal is carried to the farthest corners of the bunkers



Coal is scooped up in buckets on an endless-chain elevator and then dropped into chutes that lead to the bunkers of the ship



Fluids are pumped up a butterfly's tongue into a bulblike enlargement in the head, from which they are forced into the stomach

The Pumps that Moths and Butterflies Carry with Them

By Edward F. Bigelow

OF marvelous mechanical construction is the tongue of a moth or a butterfly. It is a trunk of peculiar and delicate structure and varying length. In most moths and butterflies it is about as long as the entire body. In some sphinx moths it measures nine inches, or more than three times the length of the body.

These tongues have always been admired for their beautiful structure in the peculiar banded appearance due to the arrangement of the muscles. Each tongue is really an elongation of the two maxillae, each one curved a little on the side, so that when they are fastened together, either by curve or sometimes by hooking, they form a tube or nearly a tube, sometimes taking the form of two troughs, with one edge of each fastened to the other and the two other edges brought nearly together. At the upper end of the trunk, in the head, is a bulblike enlargement.

In the walls of each are muscles that have their origin on the inner wall of the head. When these muscles contract, a partial vacuum is produced, and the fluids in the flower cup are pumped up the trunk, or tongue, into the bulb, from which they are forced into the stomach. The process of feeding is mechanical in action, similar to the action of a bulb syringe.

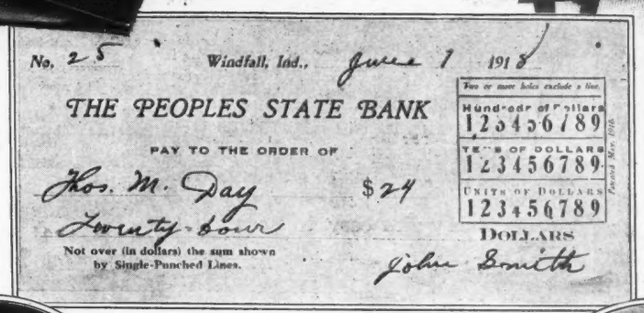
Note in the illustration the papilla of taste at the end, in appearance somewhat like candles.

For Office Efficiency

Contrivances that help to shorten the day's labors

At each end of the blotter is a wing. When the writer is interrupted, the wings may be folded so that they completely cover as well as blot the papers beneath them

Press the bulb on the side of the bottle and the ink is forced through a short spout, a drop at a time, into the drawing-pen. There is no possible chance of its spilling



No. 25 Windfall, Ind., June 1 1918

THE PEOPLES STATE BANK

PAY TO THE ORDER OF Thos. M. Day $74

Twenty-four DOLLARS

Not over (in dollars) the sum shown by Single-Punched Lines.

Two or more holes exclude a line.

Hundreds of Dollars 1 2 3 4 5 6 7 8 9

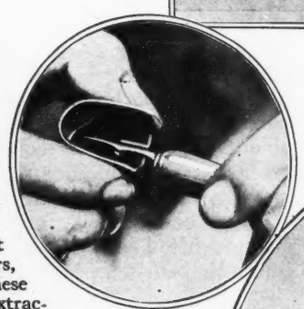
Tens of Dollars 1 2 3 4 5 6 7 8 9

Units of Dollars 1 2 3 4 5 6 7 8 9

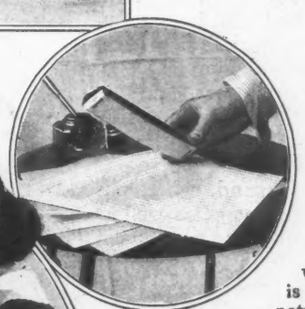
Patented Nov. 1916

John Smith

This kind of check cannot be tampered with. The amount is punched out of the numbers at the right after writing in as usual



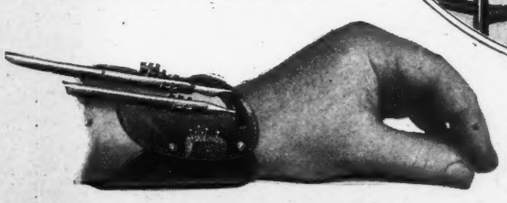
If you strenuously object to dirty fingers, buy one of these pen-point extractors. One quick jerk with this little device, and out comes the pen

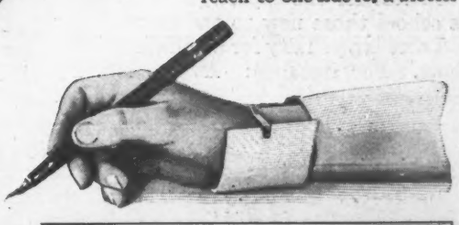


Eight inches long and half an inch wide, this pad blotter is just right for signature blotting. When one sheet is soiled it is very quickly removed

For clerks, saleswomen, school children, and in fact anybody who does much writing, comes this cuff-like attachment to conveniently hold pencils, pens, blotter, and pins

A blotting-paper shield worn around the wrist will enable the wearer to blot figures or words without having to reach to one side for a blotter





With this addressograph attachment anybody can list names at the rate of sixty a minute. The device is attached and detached quickly from the machine

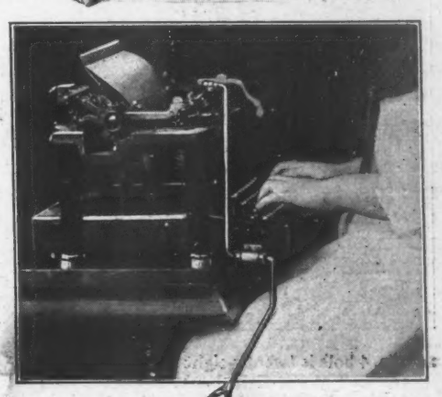
Made of steel wire and sliding down upon the pencil, the clip is also a sharpener and a finger-nail cleaner

x x x x x x

Montgomery Peter R

1	2	3	(4)	5	(6)	7	8	(9)	(1)
q	w	e	(r)	t	(y)	u	i	(o)	(p)
2	3	4	5	6	7	8	9	1	
a	s	d	f	g	h	j	k	l	
2	3	4	5	6	(7)	(8)	0		
z	x	c	v	b	(n)	(m)	.		

A code that does away with the numerous delays incidental to an alphabetic recording system and classifies entirely by numbers instead of in the old way by names



With a pushing movement of the knee the typewriter operator sends the carriage back to its starting point

The Golf Course

A miniature course that demands

By Edward

Having played the ninth hole, you pass through a summer-house, where on tournament days the golfers are served refreshments

PINEHURST, North Carolina, has much to boast of in its golf and golf courses, but the miniature golf course at the new home of Mr. James Barber, "Thistle Dhu" has some unusual features.

It comprises eighteen holes of which no two are alike. The first nine holes are divided from the second nine by a terraced garden, fountain, summer-house, flower bed, and iris garden.

The course will materially assist the landscape work when completed, as much of the nursery stock had yet to be put in at the time these photographs were taken.

The ground on which the course was laid out is entirely of sand, the greens being elevated for drainage, as well as to give the shrubbery plenty of water.

The elevation of the greens was done with sand taken from the foundation of the house. This was well rolled down. On top of it was laid some six inches of clay, which was again rolled, tamped and molded into shape. It was then sanded. Sand putting greens are used in Pinehurst. To cross the valleys the player makes use of wooden bridges.

The Thistle Dhu course was laid out to force the player to carefully study each shot and also to provide a good test for the expert golfer as well as school those new to the game.

There is a penalty for all off direction shots. For instance: At the No. 1 hole there is a small oak tree about sixteen feet from the tee in direct stymie to the hole. The line of put is a few inches to the left of this tree. It is also necessary to put a slight cut on the ball as well as to give it perfect distance. Then, you may get your one. It is quite easy to accumulate a good-sized score on almost every hole if the eye is not on the ball and the mind is not working in unison.

The line of put on the No. 1 hole must be a few inches to the left of the oak tree, with a slight cut on the ball

With the elevated greens, if the ball is over-played and lodged in the shrubbery, in many instances it would be impossible to play back. So as to make an over-played shot fair to all there are wooden bunkers under which the ball will roll and stick. From this position the ball may be lifted, but placed no nearer the hole, with the penalty of one stroke.

We have found in practice that, outside the regular rules of golf, the following deviations were all that were necessary.

1.—All shots must be made with the putter except the tee shots at the 5th, 8th, 12th and 17th holes.

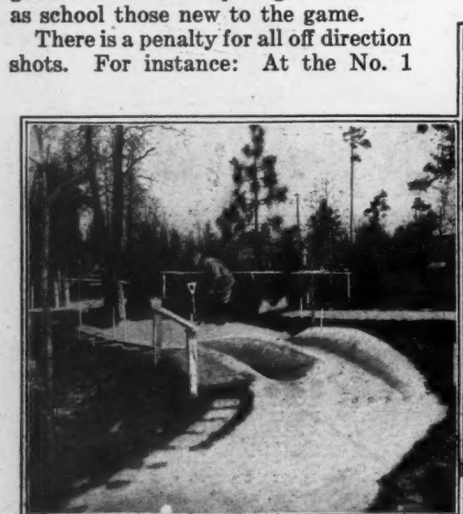
2.—On the 5th, 8th, 12th, and 17th holes, a ball played short of the fences or outside of the clay confines of the greens is out of bounds. Tee-up and play next shot (no penalty).

3.—A ball played under a bunker may be lifted and placed not nearer the hole, penalty, one shot.

4.—Out of bounds marked by boundary stakes.

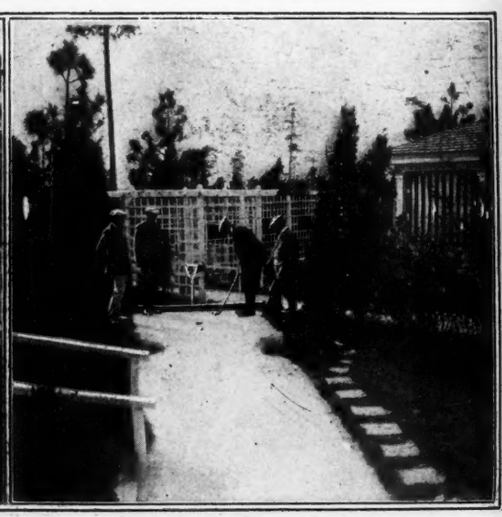
In the preceding text we have played the first hole. We now proceed across the wooden bridge to the 2nd hole, which is thirty-one feet long. Here we find, apparently, a perfectly straight flat put with nothing in the way but the cup. In reality this is a very difficult hole, for the ground has a slight slope to the left necessitating a put that requires study.

At the No. 3 hole, which is thirty-one



No. 4 hole is twenty-eight feet long. Play the ball at the right bank, so that it rolls to the left and will then divert to the hole

No. 7 hole is twenty-nine feet long. It has a clay approach of twenty feet. It is the only grass green in Pinehurst



No. 9 hole is twenty-four feet long and made to look rather longer than it is. Two side bunkers and a wooden bunker for overplay

# of Thistle Dhu

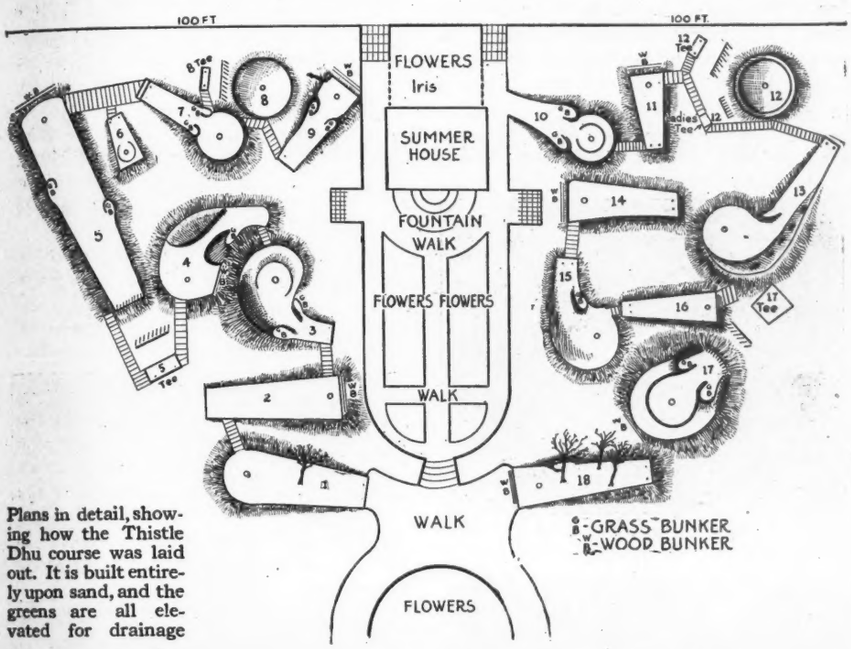
all the skill of the expert golfer

H. Wiswell

Hole No. 17 is a difficult shot to play. The ball must be well lofted, with sufficient back spin to hold it well within the horseshoe

feet long, we have confronting us, to the right and left, a grass trap surrounded by clay bunkers (grass has been used in the traps, instead of sand, for the purpose of keeping the greens clear and clean). The shot is played through the center to the sloping bank, where the ball, if properly played, will roll toward the elevated green. If you over-play this hole you must make the return shot with excellent judgment to remain near the cup.

At the 4th hole, which is twenty-eight feet long, you are presented with a new problem. To have your ball remain near the cup it is necessary to make use of a two-cushion carom. As you stand on the tee you have before you, at the left, a clay bunker with a grass trap. Immediately behind the trap is a high bank of clay. The proper play on this hole is to have your ball roll up the right hand bank in such a manner that on its descent it will roll up slightly on the left bank (the bank behind the grass trap). It will then roll toward the hole. The player new on the course will think the proper shot is to make use of the valley and the right hand bank alone. He will invariably find himself tucked away in the wooden bunker at the left hand side of the green placed there for the purpose.



Plans in detail, showing how the Thistle Dhu course was laid out. It is built entirely upon sand, and the greens are all elevated for drainage

No. 5 hole is seventy-one feet long and has its own tee. It is elevated some two feet. You tee your ball up and play a short mashie pitch over a fence and hedge (in the hollow) to the green. There are two grass traps on this hole, to the right and the left. Excellent practice is obtained here for short mashie work.

No. 6 hole is twelve feet long and is the shortest hole on the course. It is just a wee put but requires delicacy of touch and an eye upon the ball. It has its own elevated green about two feet in diameter, with out of bounds beyond the clay confines of the green.

No. 7 hole is twenty-nine feet long and has a clay approach between two clay bunkers—with thick grass as penalty for faulty direction—to the turf putting green.

No. 8 hole is twenty-two feet long. You use a mashie niblick for a back-spin shot, from an elevated tee, over a fence and hedge, to a clay saucer green with sloping sides. If the ball does not go in on the direct shot you get it occasionally on the return roll.

No. 9 hole is twenty-four feet long.

No. 10 hole is twenty-six feet long. Perfect direction, and full allowance for the slope, and you will hold the elevated green

No. 12 hole is twenty-eight feet long. A niblick shot. The green is a double circus ring

A tournament day at Thistle Dhu at the finish of the eighteenth hole. The guests meet at the summer house

This hole is made to look rather longer than it really is. There is a clay approach through two side bunkers with long grassy traps. At the end is placed a wooden bunker.

Having finished the first nine holes, we go through the summer-house, where we find drinking water and on tournament days refreshments.

No. 10 hole is twenty-six feet long. Perfect distance and allowance for the roll of the approach, through two sidetraps of clay, with a grass center to an elevated green, is needed for a successful shot. If the calculation is faulty the ball will roll to the grass at the sides of the green, or at the back, where it is very difficult to return and hold the ball on the elevated green.

No. 11 hole is eighteen feet long. This can be negotiated with an ordinary put, with allowance for the roll of the green.

No. 12 hole is twenty-eight feet long. A mashie niblick shot with a back-spin is the shot on this hole; from an elevated tee, over a fence and hedge, to a double circus ring with a hole in the center. The sides slope so that you have a chance to go to the cup direct or upon the return roll.

No. 13 hole is forty-seven feet long. Perfect direction takes you through two side bunkers of clay, with grass at the centers; in the left bank are a continuation of grass traps. A good put carries you sloping through the two side bunkers to the sloping bank, where the ball will turn toward the hole.

No. 14 hole is twenty-eight feet long, and is a good level put. There is a wooden trap for over-play.

No. 15 hole is twenty-four feet long. This is a dog-leg hole and is so designed that if you have perfect speed on your ball the side banks will turn its direction toward the hole for a one. Over-play is out of bounds.

No. 16 hole is twenty-three feet long and is a plain flat put.

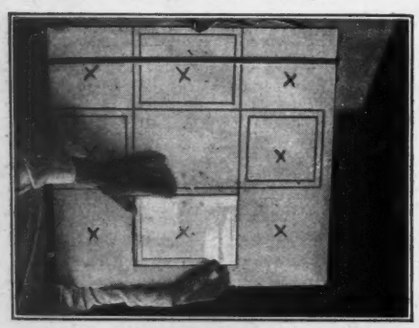
No. 17 hole is forty-seven feet long, and you go down a few steps to the tee. The green is elevated some five feet. Use a niblick from the tee. As you stand on the tee, in front of you is a privet hedge, then a sloping bank of grass, some five feet high, on top of which is a small wooden fence. The ball must be well lofted and have sufficient back-spin to hold within the horseshoe, which is about eighteen inches in height, with sloping banks on each side. In case of an over-play, if in direct line with the hole, the ball will go under the wooden bunker from which you lift with penalty. Then you find a very difficult shot to play back over the raised horseshoe to the green. This is one of the holes on which the local rules apply.

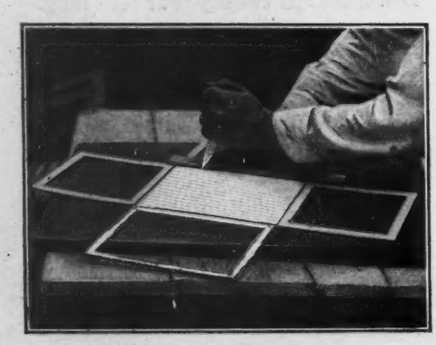
No. 18 hole is thirty-four feet long and the put requires much judgment. A slight up-grade, three oak trees to wheedle you into taking your eye from the ball, two sidetraps in which you can be tucked away, and a wooden bunker at the back of the green for over-play. This completes the course.

[The Thistle Dhu Golf Course was laid out by Mr. Edward H. Wiswell, of the Montclair Golf Club, Montclair, New Jersey.—EDITOR.]

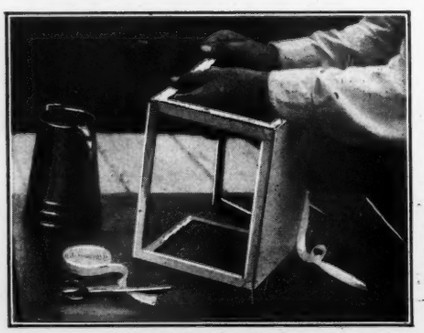
How to Make a Cardboard Aquarium—*By* E. B. Bade

First, take a large piece of cardboard and draw on it the aquarium in outline. A piece of glass cut to the right size will help

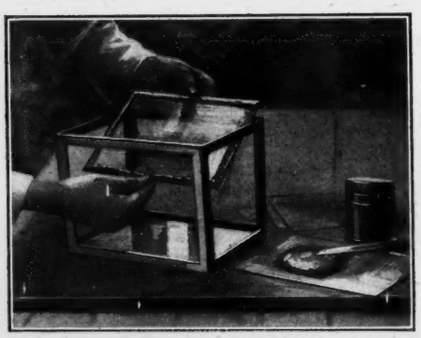




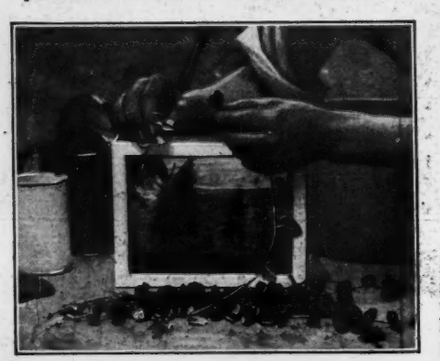
Next cut the outer edges with a chisel. Cut them carefully so as to get sharp corners and avoid ragged edges. All of the parts are then cut with a sharp knife



After the frame is bent, glue strips of cloth along the edges. Then soak it in linseed oil

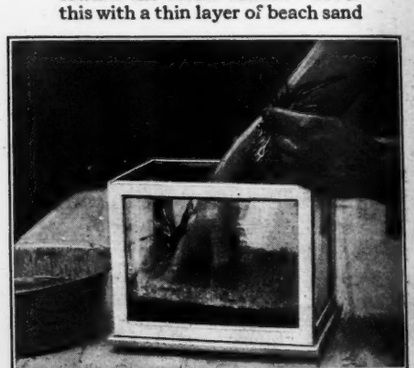


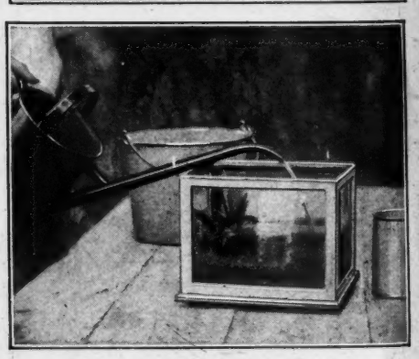
The bottom now receives a p'ate of glass, puttied in so that no air-holes will form



When the aquarium is full cover it with a glass plate. We are now ready for the little aquatic plants; with a little care, they will remain green for a long time

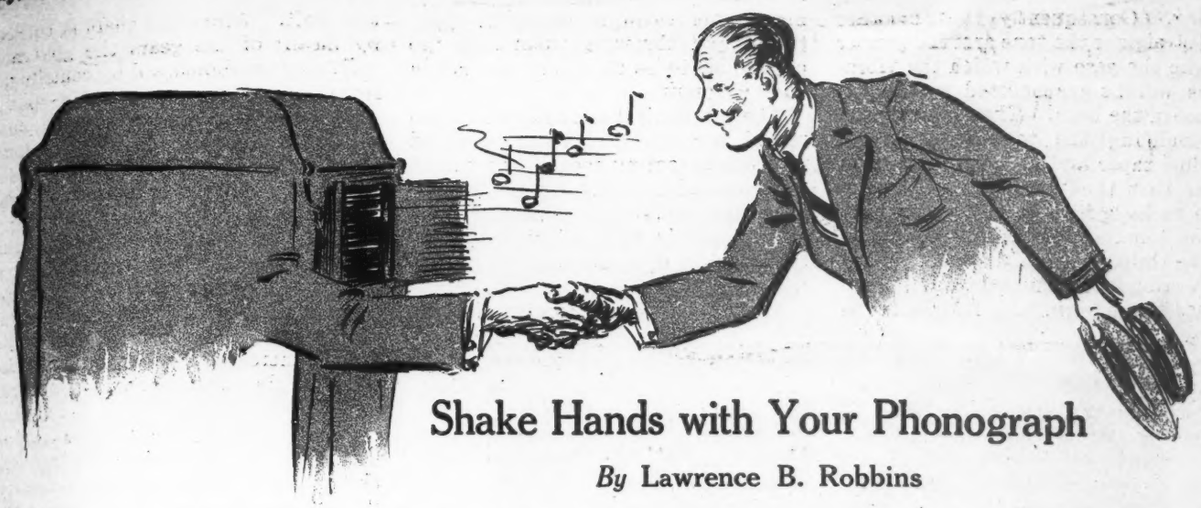
Now place the soil in the box in such a manner that it will slope toward the refuse corner. Cover this with a thin layer of beach sand





Before pouring in the water, lay a piece of paper over the sand. When the aquarium is about one third full, remove the paper and then fill to the top

And now it's all ready for the fish. Japanese goldfish show to the best advantage if an electric light with colored shades is placed behind the aquarium



Shake Hands with Your Phonograph

By Lawrence B. Robbins

YEARS ago, when our grandmothers were little girls and our grandfathers were running around bare-legged, the parlor organ was the principal source of music in the home and was a thorough evidence of distinctive social standing and marked musical proclivities.

To-day, however, the phonograph holds sway and the modern household is an incomplete institution without some sort of "talking-machine" to fill a spare corner in the living room.

But, although the day when the phonograph was regarded as a toy or mechanical novelty has passed, and unbelievable strides have been achieved in improvements and manufacture, there are still people who look upon it as a machine of magic.

Ask a business man how his telephone works and nine chances in ten he can't tell you. Ask the farmer why a pump draws water from the earth and he'll hedge for an answer. But,—the aura of mysticism that radiates from the modern phonograph! Multitudes listen to it with no conception of its manner of working.

Now, to explain is not easy, yet it is evident that it would be doing a service to lay bare the construction and operation of the modern phonograph in order that the user may understand it.

The average machine consists, essentially, of the cabinet, motor, tone mechanism and horn.

That is all as simple as dissecting a stove, which consists of legs, fire-box, covers and flue. But, to commence at the beginning, let us look for a moment at the source of all phonographic music: the record.

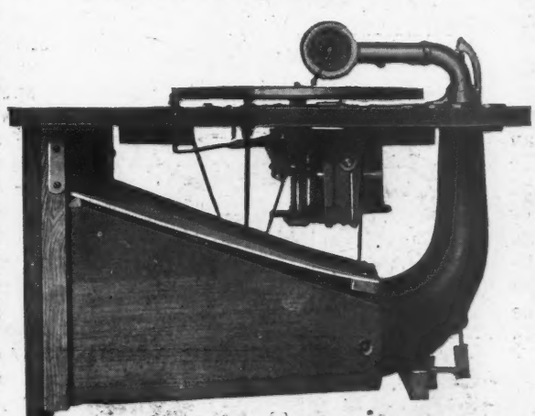
The record is apparently nothing more than a disk of a hard, black substance upon which is scribed a spiral groove. Upon closer investigation, however, it will be seen that the groove is not as smooth as it seems, but that its side walls, or channel, waves in and out in minute waves, not unlike those of the ocean. This condition is due to the fact that the wave-like vibrations, of which all musical tones consist, are transmitted to the record material, when soft, by means of a vibrating needle pulsating in accordance with the varied shades and pitch of tone.

The soft record is placed upon a revolving table turning at a uniform speed—usually 80 revolutions a minute. A delicate diaphragm, upon which is suspended a cutting point or needle, is then lowered upon the revolving disk. This cuts the groove. When the voice or musical tone strikes this diaphragm it commences to vibrate and causes the cutting point to dig in and out of the record's surface. The constant passage of the record under the needle results in these pulsations being extended or elongated into a continuous line of undulations which are scarcely perceptible to the naked eye.

This is called the master record and is used in the formation of a metal die, from which are struck, or pressed thousands of exact reproductions.

The cabinet, as an element of musical production, need not be considered. It is merely a means of supporting the mechanism and of hiding its nakedness.

The tone mechanism consists in itself of the sound-box or reproducer, the tone-arm, the throat and the horn. Each one of these parts is necessary in order to gather, amplify, and distribute the sound waves from the undulations of the record as they pass under the point of the playing needle attached to the reproducer.



Of course you own a talking-machine, but do you understand its mechanism and how to care for it?

The reproducer itself consists of four parts; the needle, the needle bar, the diaphragm and the metal cell in which they are assembled.

The diaphragm is commonly composed of a circular sheet of thin, selected mica, although in some cases the manufacturers utilize hard rubber or some patent composition. This disk is laid in the cell and insulated from it by means of rubber washers above and below. Then the needle bar is cemented to the diaphragm at its center and conveys the vibrations directly to the needle.

From the fact that the needle bar is attached to the diaphragm at its center, it is of course apparent that the vibratory impulse is at once transferred to that center from whence it gathers momentum and spreads out in circular waves through the diaphragm, exactly as circular waves spread outward in calm water when a stone is thrown into it. In the case of the water the waves continue to spread without interruption until exhausted, but with the reproducer it is somewhat different. The sound waves are hemmed in by the circumference of the diaphragm to such an extent that they beat against the cell walls and travel back towards the center.

It is the passing to and fro of these waves in a properly designed and proportioned reproducer that produce perfect notes or, in other words, true musical tones. Where the conditions are unsuitable for the free passage of sound waves foreign noises result and the tone is interfered with, causing husky and unmusical tones.

We have seen the manner in which the vibrations acquire their start from the record and the manner in which the diaphragm transfers them to the air. From the reproducer they pass along the tone arm.

The tone arm serves a single purpose: that of conveying the sound waves to the throat of the horn. Understand that it is the vibrations and not the air that passes through the tone passages and that it takes a certain amount of power or effort to transmit vibrations as it does to transmit water or steam through

piping. Consequently the smoother and straighter the tone arm the greater will be the ease with which the vibrations will be transmitted to the entrance of the horn. That is the reason for building the tone arm with a gradual taper and rounded corners in order that the vibrations will travel with as little friction and consequent loss of tonal quality as possible.

The throat is a tapering passageway connecting the tone arm to the entrance of the horn. By its means the horn may be placed in a convenient position for the listener and a practically clear, unobstructed passage afforded through which the tones can reach his ears. This throat is generally constructed of metal, but wood is gradually finding favor on account of superior tone qualities.

An illustration of sound waves set in motion by the human voice

When the tones reach the horn entrance they are confined to a very limited area and are therefore under considerable pressure. It is the function of the horn to relieve this pressure and to spread and amplify the tones so as to be readily detected by the ear. We all know how thin and transparent the music sounds when the horn is removed and the tones allowed to issue from the throat alone.

The horn of the modern cabinet phonograph is of a flaring, rectangular shape instead of the conical style of several years ago and for a very good reason. Each surface acts as a separate sounding board which assimilates the tones and then transfers them to the air. This is done in conjunction with the passage of the sounds along the surfaces, the whole operation magnifying them in intensity many times, and throwing them into the outside air to be caught by the ear in all their original quality.

The mechanical means by which the record is revolved at a uniform speed is a simple spring motor, not unlike the works of a clock. No matter how large and powerful the motor or how complicated in appearance it may be, the principle of operation is invariably the same.

Motors in general consist of three principal parts: the spring, train of gears and the governor. Phonograph motors are equipped with from one to four springs and are therefore designated as a single or compound spring type. In each case, the spring units are enclosed in steel "barrels" or drums to protect the mechanism or the operator in the event of a spring breaking.

The number of springs used determines the length of time the motor will continue running on one winding, and the number of records it will play. Consequently it is the duty of the governor to keep the speed of the turntable constant and produce the maximum number of revolutions from it with the smallest reduction in the spring tension. Its operation is as follows:

Two or three heavy metal balls are attached to as many straps of thin, flexible steel. These straps are, in turn, attached by their ends to two disks. A small shaft is passed through a hole in the center of one disk, and held stationary to it, while the opposite disk slides back and forth on the shaft. When this shaft is turned by means of the gears the governor balls are forced outward by centrifugal force in proportion to their speed. This causes the straps to bow outward and pull the movable disk along the shaft until, at the maximum speed, the disk bears against a leather finger which holds it from traveling any farther. Thus the speed remains the same as long as there is sufficient force left in the springs to turn the gears. By moving this finger (with the regulating lever) the tension against the disk is increased or relaxed and the speed of the turntable varied accordingly.

Look after your phonograph as you would your automobile. Neglect will always mean inefficient reproduction of your records and, if you prize your selections in the least, it is evident that to hear them played indifferently is always more or less disturbing. Keep the motor oiled according to directions. Periodic variations in the speed will cause a hideous flatting and sharping of the tones.

Be sure to test out the speed of the turntable occasionally, as its speed will sometimes vary due to the condition of the motor. Keep it at the speed necessary to play the records you are using. Understand that a machine will play a record at almost any speed, but to hear it reproduced at the proper pitch it is necessary to reproduce it at the speed at which it was recorded.

Use clean needles and keep the records dusted out.

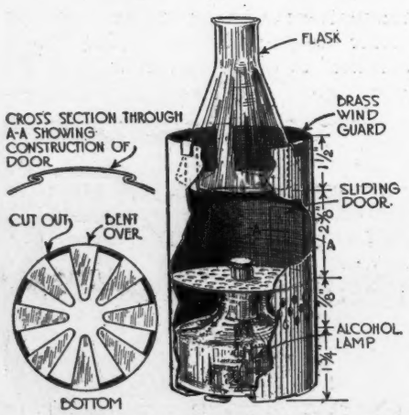
Go over the various nuts and adjusting screws frequently and see that there is no undue play, as such conditions will produce rattling and vibrations foreign to true musical tones.

Insulate the machine from the floor by setting it on a carpet or rug and, if practicable, place it in a corner of the room. The two walls back of it will tend to spread the sounds throughout the whole room, and give an exceedingly pleasing effect.

Every Farmer Can Be His Own Chemist

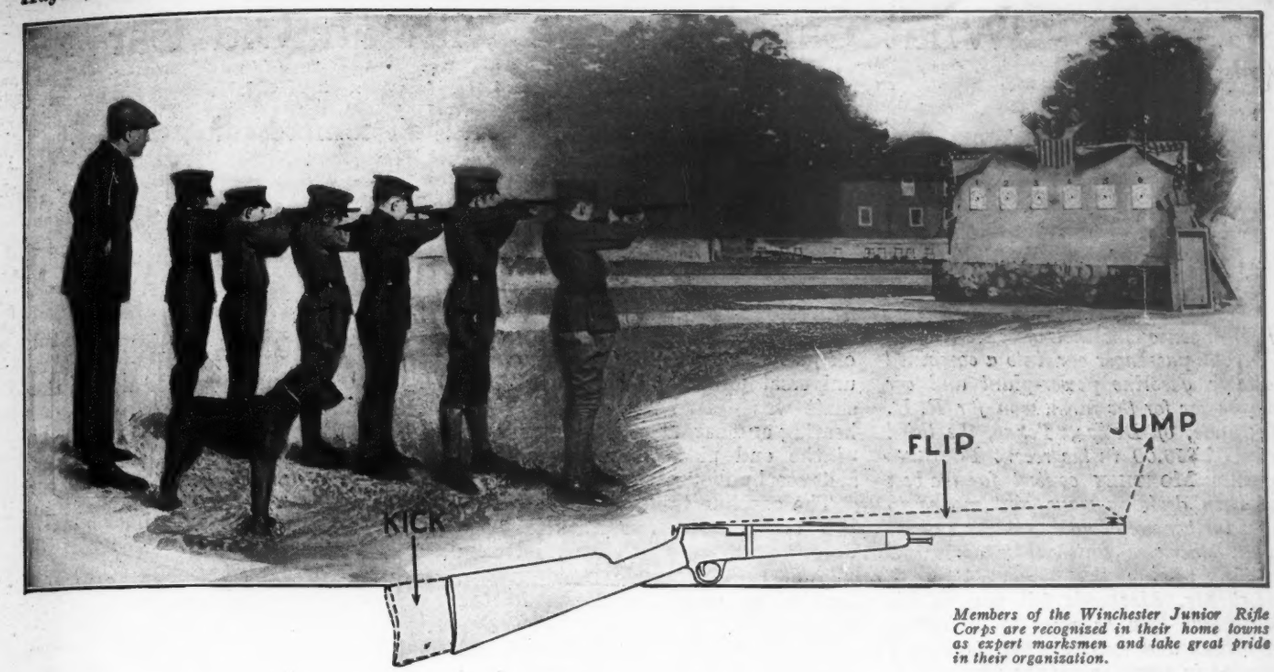
ONE of the greatest aids to practical, scientific farming ever devised is the Truog Acidity Test for determining the acidity of soils quickly and accurately in the laboratory, farmhouse or open field. The accompanying line illustration shows the apparatus in detail.

The test depends upon the fact that zinc sulphide, when mixed with an acid, will liberate hydrogen sulphide gas, which discolors paper moistened with a solution of lead acetate, or sugar of lead. A small metal cup, having a capacity of 9 cubic centimeters, is filled with the soil to be tested. This is emptied into the boiling flask and 5 cubic centimeters of a mixture of zinc sulphide and a solution of calcium chloride, together with 95 cubic centimeters of water are added. The alcohol lamp is lighted and after the contents have boiled for just one minute a strip of the dry lead acetate paper is placed over the mouth of the flask and the boiling continued for just two minutes more. The paper is then removed and its color noted. If the under side has been darkened the soil is slightly acid. If it is yellow to brown in color the soil is more or less acid and if brown to black very acid.



Here is the apparatus in detail. It is very simple to make

This test is much more positive and certain than the old litmus test. It indicates the degree of acidity of the soil, and from the data thus obtained the farmer can find the quantity of lime per acre needed to correct it.—FLOYD L. DARROW.



Members of the Winchester Junior Rifle Corps are recognized in their home towns as expert marksmen and take great pride in their organization.

What makes a gun "kick"

Points about rifle shooting which you learn in the W. J. R. C.

Sharpshooter Medal

EVERYONE who knows anything about guns knows what "kick" is. But do you know what *makes* a rifle "kick," and why a high-power rifle "kicks" so much more than a .22?

When you pull the trigger the bullet starts forward, driven by the gases from the burning powder. The weight of the bullet and the resistance of the air tend to check the progress of the bullet. If this resistance were great enough the bullet would stand still and the gun would be shot back. But the bullet is so much smaller than the rifle that it moves forward at high speed, and the gun moves very little.

High power rifles have a hard "kick" because their big bullets travel at high velocity and meet with great resistance. This forces the rifle back against the shoulder.

The .22 bullet is small and has a low velocity. As a result, there is hardly any noticeable recoil, or "kick." This is one reason why the .22 is *the rifle* with which to start shooting.

To know just what makes a gun "kick" may not seem to you to be essential to good shooting, but the fact remains no boy or man ever became an expert shot unless he knew every little trick of his gun. *You must know your gun as if it were a live thing.*

The boys of the W. J. R. C. have a great advantage over the fellows who don't belong to any recognized rifle club. They get all the shooting instructions they need to become real experts in the use of rifles. They have competent men to teach them all the fine points of shooting.

Start a W. J. R. C. Unit with your friends

Why not get together with half a dozen of your chums, join the Winchester Junior Rifle Corps and organize a regular Unit which will be officially recognized by National Headquarters? Any boy who gets a Unit started receives a Special Service Pin.

The W. J. R. C. will help you from start to finish in rigging up an indoor or outdoor range. It provides for officers, supervisors and adult instructors to make your shooting safe.

It costs you nothing to join the W. J. R. C. There are no dues and no military obligations.

The W. J. R. C. was organized solely to encourage better marksmanship and better sportsmanship among boys and girls of America. It is intended to develop the qualities of fair play and manliness which are essential to success in after life. Any boy or girl not over 18, who is in good standing in his or her community, is eligible.

Membership in the W. J. R. C. covers the entire United States. There is hardly a town now that has not at least a small Unit where boys are competing for the famous Winchester Marksman, Sharpshooter and Expert Rifleman Medals.

Get the official plan and rule book

Write today for the Winchester Junior Rifle Corps "Plan for organizing a W. J. R. C. Unit," and for the official rulebook "How to handle a rifle safely."

This booklet tells you all about the W. J. R. C. and describes in detail the fine points of shooting—alignment of sights, the three correct positions, rules for gun safety, the care of rifles, and the proper rifles for you to use.

If you are a boy scout or a member of any other boys' organization, state what organization and give the name of the official in charge.

National Headquarters

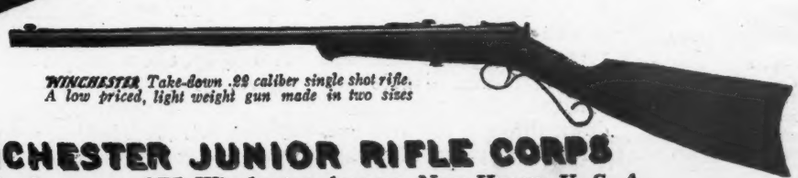
Winchester Junior Rifle Corps

275 Winchester Ave., New Haven, Conn., U.S.A.

Division 820

Standard types of .22 caliber Winchester Rifles, popular with members of the Winchester Junior Rifle Corps

WINCHESTER MODEL 90. Take-down repeating .22 caliber rifle, 24-inch octagon barrel. The standard target rifle for over 25 years.



WINCHESTER Take-down .22 caliber single shot rifle. A low priced, light weight gun made in two sizes

WINCHESTER JUNIOR RIFLE CORPS

National Headquarters, 275 Winchester Aveuue, New Haven, U. S. A.

Winchester Junior Rifle Corps
National Headquarters,
275 Winchester Ave., New Haven, Conn., U. S. A. Division 820

Gentlemen:

Please register my name as a member of the Winchester Junior Rifle Corps, and send me a membership button and certificate of membership. Also tell me how to organize a Local Unit of the W. J. R. C.

Very truly yours,

Name _____

Street Address _____

City _____ *State* _____

What Can Be Done with an Old Car

Converting an old automobile into a portable combination power plant and air-compressor

By R. H. McQuade

AN ingenious method of converting an old passenger car into a combined portable gasoline power-plant and air compressor for the farm, won for R. H. McQuade, of Dallas, Texas, the third prize of $50.00 in the recent POPULAR SCIENCE MONTHLY *contest for the best ideas in devising ways and means to make further use of old automobiles which would otherwise finish their career on the junk pile.*

Let Mr. McQuade tell you in his own words how he came to devise his apparatus and exactly what steps were followed in working out the idea.

HAVING on hand a badly worn automobile of popular make, I decided, rather than buy the many new parts needed for repairs, to convert it into a portable combination farm engine and air compressor. The rear construction was so badly worn that I discarded it entirely. The remaining parts were dismounted down to the frame, and the front cross member of the frame was moved back and spaced so that the engine could be remounted on the rear of the frame. Before being mounted the frame was heated and bent as shown in the accompanying sketch, and the holes were drilled for bolting the engine into its new position.

A pillow bearing was mounted on the under side of the rear cross member of the frame, and was put in line with the engine by placing a wooden block between it and the cross member, using long bolts that passed through the cross member block and bearing.

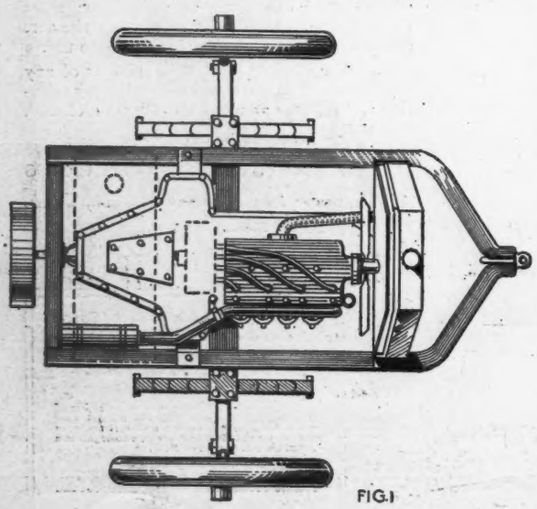


FIG.1

When operating the engine on two cylinders it develops about 10 H.P. Opening the globe valve cuts out the compressor

The drive shaft housing was sawed off just at the back of the drive-shaft universal joint, and then the drive-shaft was passed through the pillow bearing and sawed off, leaving enough of the end piece to mount a 16-in. split steel pulley with a 4-in. face.

The gasoline tank was mounted on ¼ x 1½-in. strap-iron brackets which were bolted to the frame on each side of the transmission cover, the location of which is shown in the illustrations.

The transmission bands and control pedals were removed and the holes in the transmission cover, through which they passed, were plugged up. This left the transmission locked into high gear or direct drive to the driving pulley.

A 4 x 4-in. timber was mounted under the engine where the radius rod ball and socket joint is bolted to the bottom of the crankcase. Wooden blocks were put in between the 4x4 and the frame and long bolts were passed down through them, thus fastening the timber securely to the frame.

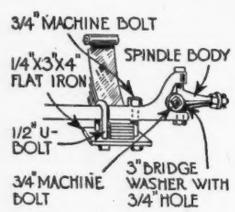


FIG.2

The new springs are adjusted and mounted on the timber in this fashion

The springs were not suitable, so they were exchanged for a pair of full elliptical springs at an auto wrecking house. These springs were bolted to the 4x4 timber with 4½-in. U-bolts.

The steering gear was all taken off and the spindle bodies were clamped to the front axle by means of bridge washers, which were placed one on each side of the spindle body. A ¾-in. bolt was then passed through both washers and the hole in the spindle body from which the steering arm was removed. This made a stiff axle. The bridge washers used were 3 in. outside with a ⅜-in. hole.

The spring perch was removed from the axle and a ⅝-in. machine bolt was inserted, and this passed down through the hole and through a piece of strap-iron ¼ x 3 x 4-in., which was drilled to accommodate a ½-in. U-bolt. The bolt was clamped over the axle on the other side of the spring.

The front wheels, which had 30x 3-in. tires, were retained to haul the apparatus from place to place.

In order to convert the engine into an air compressor, it was necessary to operate it as an engine on two cylinders and use the other two for compressing air. The first and last cylinders were used as the engine and the second and third for the air compressor. In order to adapt these for this purpose it was necessary to cut off both the intake and exhaust valve stems of each cylinder about an inch, and redrill the holes for the pins that held the valve springs in place. These new holes were drilled about ½-in. from the end of the valve stem and all the stems were threaded with a 5/16-in. die for ½-in. size; then, four sleeves were made from steel tubing 1¼ in. long and tapped out at one end with a 5/16-in. tap. These sleeves are used when it is desired to run the engine under normal conditions, that is, as a four cylinder engine without the compressor.

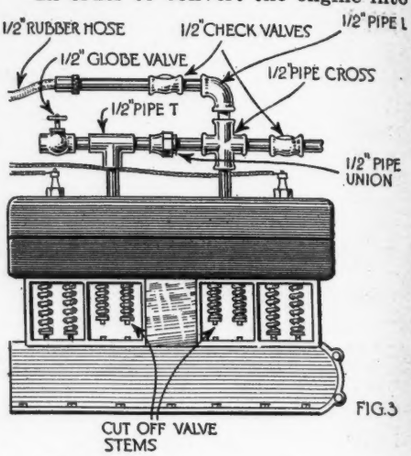
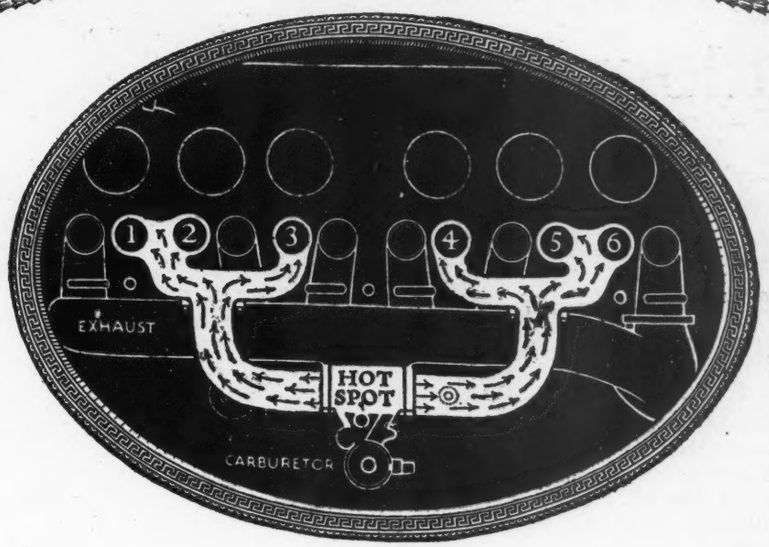


FIG.3

How the valve stems are cut to convert the engine into an air-compressor

When using the air compressor these sleeves were removed as this pushes the valve stems up out of reach of the push rods from the cam shaft and puts them in a closed position. Then new air valves were supplied from pipe fitting, which required nine ½-in. pipe nipples, one ½-in. cross, one ½-in. L, one ½-in. union, two ½-in. check valves and one globe valve. These fittings were assembled and placed in the spark plug holes. The engine is trailed behind a car or horse wagon. It weighs about 750 pounds.



Fitting the Engine to the Fuel

THE engine fuel that is now called gasoline is really a kind of kerosene. But your engine is a gasoline engine.

Gasoline of the old kind—the kind that automobile engines are intended to burn—can no longer be obtained except at drug store prices.

Your engine cannot start easily; it carbonizes quickly; it develops knocks; it does not deliver all the power that you expect of it.

There is only one way to meet the situation, and that is to build an engine to use the fuels of today.

That is exactly what the Chalmers engineers have done.

In the first place they studied engines and fuels. They discovered that some of the so-called gasoline is not consumed at all. It is so heavy that it is not vaporized. It is swept in drops into the manifold and into the engine. And these drops collect in the crankcase and "cut" the lubricating oil. That means scored cylinders, cut bearings, "knocks," heavy repair bills.

The Chalmers engineers decided that drops of raw fuel must not collect in the manifold. So they created the Hot-Spot in the manifold. When a drop of fuel strikes that spot it is instantly vaporized. Raw gasoline cannot possibly find its way into the cylinder.

The result is almost miraculous.

The Chalmers engine starts easily. In thirty seconds on the coldest day it is running perfectly. No gasoline can creep into the crankcase to ruin the lubricating oil. Hence there is less trouble with carbon deposits, "knocks," scored cylinders and bearings.

And that is not all.

The Chalmers engineers have given the manifold a Ram's-horn shape. A corner is rounded with difficulty by a swiftly moving body. The mixture is literally flashed from the manifold to the cylinders. If it strikes a sharp angle it is checked.

The Chalmers engineers got rid of all sharp corners and angles by giving the manifold the easy curves of a Ram's-horn. All the cylinders receive the same quantity of mixture at the same time. That means easy running, a wonderful freedom from vibration.

In no other engine will you find the Hot-Spot combined with the Ram's-horn manifold. That is why the Chalmers is the most wonderful engine in the world today.

CHALMERS · MOTOR · CAR · CO. Detroit, Mich. U.S.A.

Quality First

This is the fourth of a series of six bulletins in which the wonderful features of the new Chalmers will be explained.

Sleeping Comfortably Outdoors

By CHARLES COLEMAN STODDARD

SOME have tried it, at home and under the most favorable conditions, and, after tossing about for a night or two, chilled and uncomfortable, have given up in disgust, when knowledge or consideration of a few simple rules would have brought comfort.

Primarily, banish from your mind the idea that expensive and specially designed outfits are a necessity. As much comfort lies in the materials of your own bed if properly used. And again, if you try yourself out thoroughly with these, when you do come to buy, you will be far better able to judge, among the many excellent outfits in the market, which one is best adapted to your purpose.

The problem of keeping warm, indoors or out, is one of insulation: not in keeping the cold out (for cold does not penetrate, despite the common belief), but in keeping the heat of the body in. The best of insulators is dry, confined air, and the best common illustration the dead-air space in the walls of houses. Wool or feathers are warmer than cotton because the fibres do not mat down so closely, and hence contain more air. For the same reason a soft, fluffy blanket is warmer than a hard, matted one, or two layers of blankets are warmer than a single blanket of their combined weight, because of the layer of air between them. Another reason is that animal fibres, such as wool, fur or feathers, have the property of carrying away the moisture thrown off by the body and do not become damp, clammy and cold.

First, then, for outdoor sleeping, the garments and covering must all be wool, camel's hair, or some similar material; not vegetable fibre, such as linen or cotton—with a single exception: If one is sleeping on the ground, a waterproof sheet of canvas beneath the blanketing to keep out the moisture, and, if one is sleeping without a tent or other shelter, as a final covering to keep off dew or rain and to prevent too rapid radiation. If one wraps himself up too closely in this waterproof covering, so as to prevent all evaporation of the moisture of the body, the waterproof will sweat on the inside; hence it is better that two or more layers of blankets be used, and the outer layer will absorb this sweating, while the layers next the body will be dry.

Second, in sleeping outdoors, one always needs proportionately more bedding underneath than over him. Inside the house, and sleeping upon a thick mattress, it is all very well to pull the "kivers" over you; but, if you are wise, when you lie down in the open, you will have fully twice the thickness of blanketing under you that you have above, and you will "roll

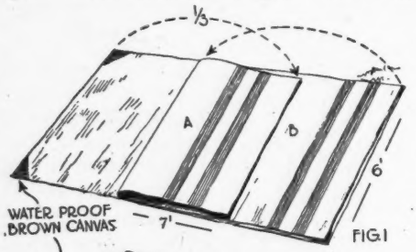


FIG. 1

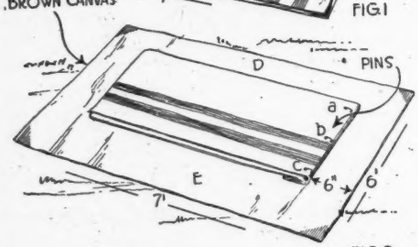


FIG. 2

The sleeping bag must be made perfectly water-tight if one is to sleep in the open

up" so that sides and back are well protected. The weight of the body, especially at the hip and shoulder, squeezes out much of the air from the bedding, and if you are not well protected, at every contact point with the ground the heat will flow away rapidly and you are certain to be chilled.

Canvas cots are almost as bad as the bare ground or the floor. The circulation of air underneath causes exceedingly rapid radiation. A folded woolen comforter (one padded with wool, or cotton) or several extra layers of blankets are the best mattress for a cot. Thin cotton mattresses or cotton comforters pack down and draw dampness if used in the open air. If you do not have these, lie on two or three thicknesses of old newspaper. A tightly-stretched cot is like sleeping on a plank floor—it has no depressions to conform to the body. Fold your coat and put it and any other extra padding under your hip and shoulder. It will repay you in comfort.

In laying a camp bed of leaves or moss, first take out all the stones and stubble; they will rise up in the most unexpected places before morning. Also make little hollows for the hip and shoulder, five or six inches deep, and fill them with the bulk of the bedding. This is where the greatest pressure comes.

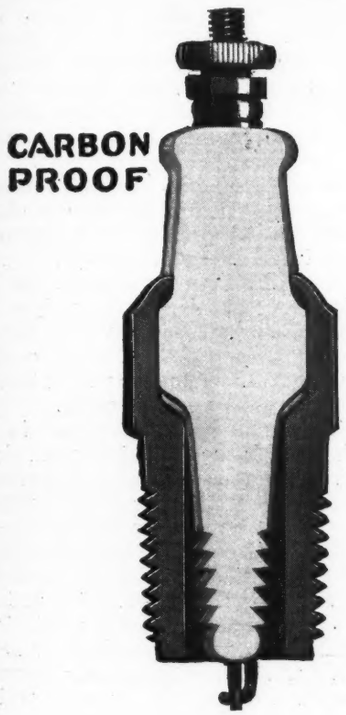
Third, remember that the coldest hours of the night come just before the dawn. This is far more noticeable in the open air than in a room. The fire dies low, the heart action is less vigorous in sleep, and often the temperature drops from ten to twenty degrees. The remedy is to arrange an extra thickness or two of blankets that can be pulled up, or that one can creep under in the cold small-hours of the night.

Fourth, never sit or lie on the bare ground. Even though the ground seems dry, by all means make a bed of some sort, soft enough to support the body at all points and thick enough to keep all parts of the body from contact with the earth. Evergreen boughs, which make the ideal bed, are not always obtainable. I have often made an equally comfortable bed of the tips of hardwood branches, particularly scrub oak with its broad leaves and springy boughs. A ticking bag, into which can be stuffed ferns, moss, grass, or dead or green leaves is a handy thing about camp

The Standard Spark Plug of the World

AC

It Defies Carbon



Note the sharp, knife-edged porcelain i– the cross section of the AC Carbon Proof Spark Plug shown above. Those sharp edges are the secret of this plug's success. When the motor is running, the thin blades attain terrific heat, which burns off the carbon as fast as it forms.

Thousands of Overland, Ford, Studebaker and tractor owners everywhere have learned the tremendous advantage in using AC Carbon Proof Spark Plugs.

If you own one of these cars or a tractor, you too, can put an end to spark plug troubles, economize on gasoline and increase the efficiency of your motor by installing a set of these plugs.

You will note the improvement immediately. You will find that these plugs permit a full spark advance without the engine knocking. That gives higher engine speed with a smaller throttle opening. Thus you save gasoline.

AC Carbon Proof Spark Plugs are especially designed for tractors, Studebaker, Ford and Overland cars.

But, remember, no matter what car you drive, there is an AC Spark Plug specially designed for it.

Most makers of high-grade cars have for years standardized upon AC Spark Plugs for factory equipment.

Still further evidence of AC superiority is the fact that AC Plugs were selected by the United States Government as standard equipment for Liberty and Hispano-Suiza airplane motors during the war.

The letters AC, are glazed in the porcelain of the genuine. Be sure these letters are on the spark plugs you buy.

Champion Ignition Company, FLINT, *Michigan*

These manufacturers use AC Spark Plugs for factory equipment

Acason Trucks
Acme Trucks
Advance-Rumely Tractors
Ahrens Fox Fire Trucks
American-La France
American Trucks
Anderson
Appeson
Appleton Tractors
Auburn
Avery Tractors
Beck-Hawkeye Trucks
Betz Trucks
Brockway Trucks
Buffalo Motors
Bugatti
Buick
Cadillac
J. I. Case T. M. Co.
Chalmers
Chandler
Chevrolet
Chicago Trucks
Cole
Commonwealth
Conestoga Trucks
Continental Motors
Crane Simplex
Daniels
Davis
Deere Tractors
Delco-Light
Diamond T Trucks
Diehl Trucks
Dodge Brothers
Dort
Duesenberg Motors
Eagle Tractors
Essex
Federal Trucks
F-W-D Trucks
Gabriel Trucks
Genco Light
G. B. S. Motors
G. M. C. Trucks
Gramm-Bernstein Trucks
Gray Dort
Hackett
Hall Trucks
Harvey Trucks
Hatfield
Haynes
Herschell-Spillman
Hispano-Suiza
Howell Tractors
Hudson
Hupmobile
Jackson
Jordan
Jumbo Trucks
Kalamazoo Trucks
Kent Concrete Mixers
Kissel Kar
Kleiber Trucks
Klemm Trucks
Knox Tractors
K-Z Trucks
La Crosse Tractors
Lalley-Light
Liberty
Liberty Aircraft Motors
Locomobile
Marmon
Master Trucks
Maxim Fire Trucks
Maytag
McLaughlin (Canada)
Menominee Trucks
Midland Trucks
Mitchell
Moline-Knight
Moreland Trucks
Napoleon Trucks
Nash
National
Nelson
Nelson Tractors
Nelson & Le Moon Trucks
Netco Trucks
Northway
Oakland
Old Reliable Trucks
Oldsmobile
Owens Light & Power Plants
Packard
Paige
Pan-American
Parker Trucks
Paterson
Patriot Trucks
Peerless
Phianna
Pierce-Arrow
Pilot
Pioneer Tractors
Premier
Reo
Re Vere
Riker Trucks
Robinson Fire Trucks
Rock Falls
Rowe Trucks
Rutenber Motors
Samson Tractors
Sandow Trucks
Saxon
Scripps-Booth
Scripps Motors
Seagrave Fire Trucks
Seneca
Signal Trucks
Singer
Smith Motor Wheel
Standard "8"
Standard Trucks
Stearns-Knight
Sterling Engines
Sterling Motors
Sterling Trucks
Stewart Trucks
Straubel Engines
Sullivan Trucks
Swartz Lighting Plants
S-S-E-Co.
Titan Trucks
Tower Trucks
Universal Trucks
United States Motor Trucks
United Trucks
Vim Trucks
Ward La France Trucks
Westcott
White
Whitney Tractors
Wilcox Trux
Wisconsin Motors
Wolverine Tractors

U. S. Pat. No. 1,135,727, April 13, 1915. U. S. Pat. No. 1,216,139, Feb. 13, 1917. Other Patents Pending.

Your Wrist Wasn't Made With a Ratchet!

That's why "YANKEE" Ratchet Screw-drivers *were* made—to save your muscles the strain of gripping and letting go the handle, perhaps a hundred times to drive a single screw!

Grasp the handle. Twist to and fro and the "YANKEE" Ratchet takes hold going forward and releases coming back; just as your muscles would have to do with a common screw-driver.

To *draw* screws, move the shifter to the back notch; to the center notch for "rigid." The changes are made instantly at the touch of your finger-tip.

"YANKEE" Ratchet Screw-drivers

	No.10	No.15
2 in. Blade	50c	55c
3 in. "	60c	60c
4 in. "	70c	65c
5 in. "	80c	70c
6 in. "	90c	75c
8 in. "	$1.00	80c
10 in. "	$1.20	
12 in. "	$1.30	

No. 15 has the handy Knurled Washer for starting wobbly screws with thumb and forefinger while hand steadies the driver. Diam. of blade, 3-16 inch.

Your Dealer Can Supply You

Write for free "YANKEE" Tool Book showing improved tools for drilling, boring, tapping, and driving and drawing screws.

NORTH BROS. MFG. CO.
PHILADELPHIA

"YANKEE" TOOLS
Make Better Mechanics

and well worth carrying. When filled with freshly-cured hay, it is about as luxurious and fragrant as balsam itself. If you are on swampy ground, or if the ground is wet, as after rain, throw down a thick flooring of heavy boughs before you spread your bed. It will keep the body from sinking into the mud, thus making a hollow that would collect all the water about you. Or, better still, if you have time, cut a flooring of logs for your tent and spread your bed upon them.

For sleeping garments, if you do not possess a sleeping suit, take along an extra sit of woolen underwear. If the night is very cold, sleep in all your clothes. It sounds unorthodox, but if you don't you will be reaching for them before morning. Pull on a soft pair of socks at night, and in winter two pair. It is the extremities that feel the cold first and chill the whole body. In very cold weather, heat a few medium sized stones beside the camp fire and place one of them at the feet inside the blankets, replacing it as needed, or use a hot-water bottle. Don't forget that your canteen makes a fine hot-water bottle. However, do not have either the bottle or the stones too hot, or in frosty weather you may induce chilblains. Pull a soft cap over your head and draw the blankets over your face covering all but the nose. Or tie one of your big woolen socks at the ankle and slip the top over your head. Perhaps, though you have forgotten it, you wore the same sort of skating cap when you were a boy—it is amazingly comfortable.

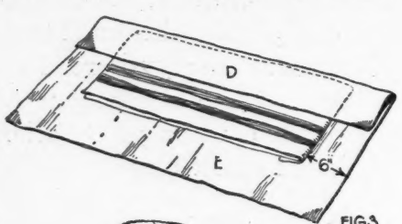


FIG.3

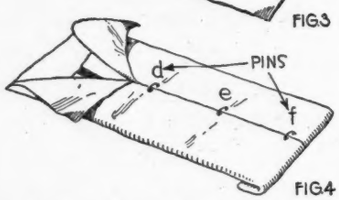


FIG.4

Here is a scientifically constructed sleeping bag with four thicknesses of blanket

For winter use, and for sleeping in the open, without tent or other cover, properly designed sleeping bags are undoubtedly best. In some situations they are indispensable. But you will usually find the "old timer" pinning his faith to a "tarp" and a blanket roll. Blankets have an unpleasant habit of climbing up around the neck and leaving the feet exposed, of bunching under the ribs, or crawling over on the next sleeper—getting anywhere, in fact, but where they are most needed. However, it is wholly possible to roll up in a blanket, or to fold it before retiring, so that it will give the best service. One noted woodsman, whom all the camping fraternity delight in honoring, for he has done more than any living man towards making life in the woods comfortable, once perpetrated a ghastly joke in regard to this. It is so good I give it in its entirety: "To roll up in a blanket in such a way that you will stay snugly wrapped, lie down and draw the blanket over you like a coverlet, lift the legs without bending the knees, and tuck first one edge smoothly under your legs, then the other. Lift your hips and do the same there. Fold the far end under your feet. Then wrap the free edges similarly under your shoulders, one under the other." You may care to try it sometime, as a test of your acrobatic propensities, but be sure there is no one around camp at the time.

I always prefer, before getting in, to fold my blankets securely into a sleeping bag that for all practical purposes equals the most expensive made. Who invented it? I know not. It came to me, minus some of its present modifications from my friend, Ralph—an experienced camper; doubtless you may be able to improve upon it yourself.

To make the sleeping bag: The materials required are six four-inch blanket pins (such as you can obtain from any dealer in horse goods) or even large, strong safety-pins.

Two blankets, or one double bed blanket (this is ample weight for spring, summer or early fall; in winter use three or four blankets, equivalent to 16 to 20 pounds weight for zero weather)—all wool, of course.

The ground cloth depicted in the diagrams is the regulation pack cloth, six by seven feet, of waterproofed brown canvas. Your poncho will do as well, or a "tarp," a piece of strong, well-shrunk canvas, a rubber lap robe, or even a couple of buggy curtains—anything that will protect you from the dampness of the ground, from falling dew, rain or snow, if you are in the open. The blankets can be rolled within it during the day, and will be kept clean and dry.

Lay the ground cloth on the ground (if a poncho, the rubber side down) and spread the blankets evenly upon it. (Fig. 1). Now, taking up one end of the spread blankets *A*, fold over evenly for about one third of their length; smooth out carefully, then fold over *B*, bringing the edges even. Now fold up one end of the roll *C* a few inches and pin securely with three blanket pins at *a*, *b*, and *c* (Fig. 2), at the same time turning the blankets around so that they lie the long way of the ground cloth. Do not pin up the edges of the blankets. They must be left loose to allow for expansion at the hips and shoulders.

Holding the edge of the roll tightly, turn the roll over so that the folded part at the foot lies next the ground cloth (Fig. 3). and pull up so that about six inches of the ground cloth extends beyond the foot or folded-

Copyright 1919
by R. J. Reynolds
Tobacco Co.

SAY, what a trick you'll turn for your tongue and taste and temper when you finally get down to bed-rock smokes and let some of that topjoy Prince Albert float into your system! Just will put the quiz into your thinktank as to how much pipe or cigarette-rolling fun you've gone shy on—and, you'll work in a lot of double headers for quite a spell to get all-square!

What's the idea kidding yourself when you know what P. A. will do for your smokespot; when you know what it is doing for men all over the civilized world! You can't hit a happier job than to stock a supply of Prince Albert, jam that joy'us jimmy pipe chuck-full and blaze away! Why, it's like falling into feathers when you've been batting-it-out-on-a-board!

Prince Albert just can't help doing you a clever turn because it won't bite your tongue at any stage! Bite and parch are cut out by our patented process. Want you to know right here, and now, that Prince Albert will be as gentle with your tongue as a toy purr-kitty is with a stuffed mouse! You can rip champeen-smokespeed-records right up the back with P. A. for packing!

You don't need a percentage table to figure out what Prince Albert's quality and flavor and fragrance will do for your happiness every time the clock ticks! You'll get the answer quick! And, now it's your draw! Prince Albert is sold in toppy red bags, tidy red tins, handsome pound and half pound tin humidors, and, in that classy, practical pound crystal glass humidor with sponge-moistener top that keeps the tobacco in such perfect condition!

R. J. REYNOLDS TOBACCO CO.
Winston-Salem, N. C.

PRINCE ALBERT

the national joy smoke

"Where's My Pencil?"

HOW many times have you asked that question? Yet have you ever really *found your pencil?* One that feels chummy and friendly to your hand and your task—that eases and quickens your work, causing less fatigue?

You can find this pencil. Our unusual little booklet "Finding Your Pencil" will tell you how. It contains personal information about how to lighten *your* work by using the correct

DIXON'S ELDORADO
"the master drawing pencil"

Write for it today. Booklet No. 120-J.

Send 15c for full length samples worth double the money, telling us what work you do and your dealer's name.

Made in 17 LEADS one for every need or preference

Joseph Dixon Crucible Co.
Established 1827
Pencil Department — Jersey City, New Jersey

Canadian Distributors
A. R. MacDougall & Co., Ltd.
Toronto, Ontario

There is a Dixon-quality Pencil, Crayon and Eraser for every purpose

New TRIPLE TONE Trumpet
Plays in C, Bb, and A

This superb Blorite "Symphony Model Trumpet" cannot be equalled for indoor and outdoor work. Just what musicians have long wanted. Prove to yourself, in your own home, its superior tone and quality.

Sent on Trial
Easy Terms

Don't buy a cornet or trumpet until you have tried the Triple-Tone Blorite. Send today for illustrated catalog, just out, of Blorite cornets, trumpets, trombones, fifes, bugles, drums, etc.

SPECIAL LOW INTRODUCTORY PRICES

Blorite Instrument House, Dept. F Naperville Ill.

ELECTRICAL CONTRACTING. By Louis J. Auerbacher. Shop system, estimating, wiring construction methods and hints on getting business. 155 pages, 225 illustrations. **Price, $2.00, postpaid.** Popular Science Monthly, 225 W. 39th St., N. Y. City

under part of the blankets. Fold *D* over, a little past the middle of the blanket roll—it should not come up too snugly to the blankets, or it will bind the broader parts of the body when you crawl in. Fold over *E*, overlapping *D* for a few inches. Tuck under the foot of the ground cloth (Fig. 4) and pin up at *d*, *e*, and *f* with the remaining blanket pins.

You now have a scientifically constructed sleeping bag, with four thicknesses of blanket (the doubled ends) under your body, just where you need them, and two thicknesses and the canvas for overcovering and protection from the elements. The flaps can be pulled up over the head in the open for protection from dew and rain. Creep under one thickness of blanket the early part of the night; and, when the cool hours of morning begin, slip out and get under another thickness. You will be surprised how comfortably the blankets conform to the body, how snugly and warmly they fit. Your feet cannot get out in the night and the blankets cannot crawl up around your shoulders or lump under your body.

Lay your bed of boughs, or heap up a pile of dry leaves in your tent, placing your pack-sack or a roll of spare clothing for a pillow; always remember to lay the head of your bed away from the opening of the tent, and your feet toward the opening and the fire.

The bough bed: Certainly nothing ever was conceived more comfortable and refreshing, more fragrant and soothing, than a bed of freshly-cut evergreen boughs, the *sapin* of the Canadian voyageurs. This is the crowning luxury of camp life and lingers longest in the memory; for it is so wholly a thing of the woods that it can be duplicated nowhere else. Balsam makes the softest and most fragrant bed, and hemlock is next, though it is rather thin and requires an enormous quantity. Spruce has a good body, but is not very fragrant. Begin at the head of the bed with the largest branches, laying several layers with the bowed or convex side up and the butts all toward the foot of the bed. Then work downward in successive layers toward the foot, letting the soft tips lap over in a thick thatch upon the bough of each preceding layer. When the foot is reached put on a good-sized log to hold the branches in place. Side-logs will make the bed hold up better, if it is to be used for more than a single night. Take the remaining fine branches and go over the whole bed as thickly as possible, sticking the butts upright through the first layer so that the soft tips curve toward the foot of the bed.

The night fire: Drive two strong stakes into the ground, sloping slightly away from the front of the tent. These should be about three feet apart and four feet from any overhanging part of the tent or lean-to. Brace these stakes from behind (the side away from the tent) with heavy forked sticks, sloping down at an angle of about 45°. Pile four or five green logs one on top of the other, in front of the stakes and leaning against them. More fortunate still if you can face your tent against a large boulder or ledge of rock that will serve as a reflector.

Cut two log andirons for your fire and place them about three feet apart. They will reflect practically all the heat into the tent that does not go straight upward. If the ground is damp when you pitch your tent, better let the fire burn an hour or two before spreading your bed. The reflected heat will dry it out. Dead wood is all right for the daytime; but be sure to have plenty of green logs to throw on just before crawling in. They will keep going for most of the night.

Fighting a Gasoline Fire Successfully

A FIRE-EXTINGUISHER should always be carried in the automobile—preferably beneath the hood on the intake side of the engine, as this is most usually where the fire starts. If it is carried upon the dash there is always the danger of it being stolen.

When the fire starts try to turn off the fuel at the tank, thus preventing the spread of the flames.

Step on the starter pedal and turn the engine over—this will usually draw the flames into the manifold and extinguish the fire.

If the drip-pan is aflame, turn the extinguisher on it before it attacks the carburetor as the carburetor parts are of metal and are easily injured.

If the flames spread to the ground under the car, push the car forward

Don't lose your head. Attack the fire coolly, and the battle is half won

with the self-starter having the low gear in mesh.

If there is no extinguisher, throw sand, flour, or any dry powder upon the flames; but be careful about throwing it upon the engine, as it is very injurious to the mechanism.

Never throw water on burning oil or gasoline.

Always remember that flames burn upward, so start your fire fighting at the bottom.

Above everything, do not lose your head.—G. F. Collins.

Grind Your Knives on the Sewing-Machine

ANY woman who owns a sewing-machine can easily have an emery wheel of her own with which to sharpen knives and smooth off the damaged points of machine needles. It will also sharpen a lead pencil more quickly and neatly than can be done by hand.

Get a roll of half-inch adhesive tape, cut off a strip just long enough to reach around the hand wheel of the machine, and press it firmly to the metal rim of the wheel. Next, cut a strip of fine emery cloth the same length and width as the tape and glue it firmly to the tape. Then wind the wheel all around with a strip of cotton cloth or muslin to hold the emery in place until the glue is dry, which will require about a day. (The

Attach a strip of emery cloth to the sewing-machine and sharpen your kitchen knives

machine may be used in the meantime for sewing as usual.)

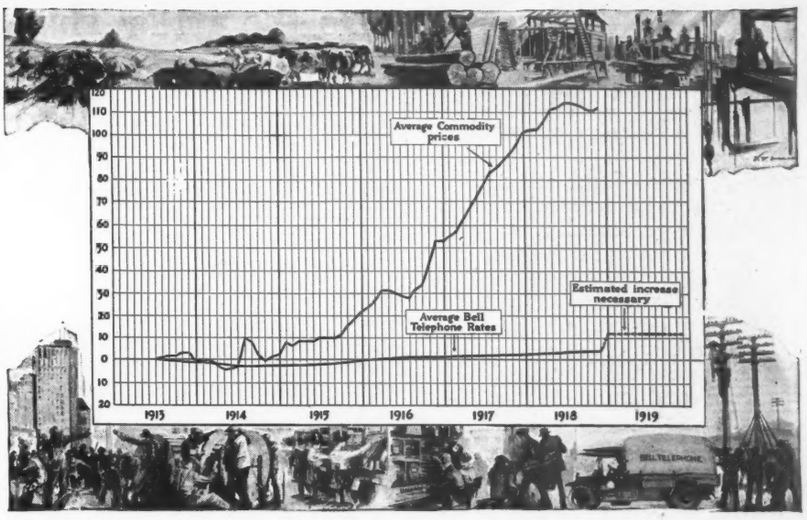
When it is worn another strip may be glued over it.—JENNIE E. MCCOY.

White Lead Better than Patent Menders

THERE are many compounds on the market that claim to mend crockery, glass, etc. In fact, the makers usually mention everything that they can crowd on the labels.

Of course we all buy this stuff, but a far better method is to take some thick white lead and smear it upon both halves of the fractured dish, pressing the parts firmly together. Let it harden well before attempting to use it, and if the piece ever breaks again it will be in some other place than where it is mended.

Sounds unreasonable doesn't it, after all the patented stuff you have tried with repeated failures? Try it and see. This isn't patented and if you want to start a good business buy some lead tooth-paste tubes, fill them with white lead, print some fancy labels, give it a name, state that the formula is a great trade secret, and you have the basis of a big business.—JOHN A. WEAVER.



A Comparison of Costs

A graphic picture of the high cost of doing business is shown by the rise in a long list of commodity prices during the past five strenuous years.

By the exercise of unparalleled economies, telephone rates have been kept almost unchanged.

The fact is, the increase in the cost of commodities has resulted in what is equal to a decrease in telephone rates. In other words: The dollar which was spent for the telephone has bought more than twice as much as the dollar spent for the commodity.

The activities of reconstruction which are now upon the nation have put a great burden upon the telephone. This condition has made necessary an advance in telephone rates.

This advance does not exceed an average of eight per-cent; almost negligible as compared with the advances in other lines of industry, yet enough to cover the increase in the cost of operation.

Only through adequate revenue can there be assured the maintenance of a high standard of telephone service.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

35 Miles per hour Is Record of this Car

Boys, Build This Car. This nifty little car driven by gasoline motor, can be built by any boy. Parts are furnished by us and are very cheap. Send 26c for building plans and price list of parts showing how to build this lad's car.

SYPHER MFG. CO.
174 Warren St.
TOLEDO, OHIO

FREE

$20

Violin, Hawaiian Guitar Ukulele, Guitar, Mandolin, Cornet or Banjo

Wonderful new system of teaching note music by mail. To first pupils in each locality, we'll give a $20 superb Violin, Mandolin, Ukulele, Guitar, Hawaiian Guitar, Cornet or Banjo absolutely free. Very small charge for lessons only expense. We guarantee success or no charge. Complete outfit free. Write at once—no obligation.

SLINGERLAND SCHOOL OF MUSIC, Dept. 402. CHICAGO, ILL.

Build Your Own PHONOGRAPH

It's Easy With Our Help

A few hours interesting work saves many dollars and gives you a machine exactly to suit your ideals. We furnish motors, tone arms, case material, blue prints and full instructions. Plays any record. You can make fine profit building phonographs for your friends.

Write Today for Our Free Blue Print Offer

Agents wanted for our ready built phonographs

Choraleon Phonograph Co.
608 Monger Bldg., Elkhart, Ind.

SAVE OVER HALF

LIGHTING

"Akron" 400 Candle-Power Lantern makes and burns its own gas from common gasoline. Brighter than electricity. Carry it anywhere. Wind proof. Dependable, cheap, safe, guaranteed.

COOKING

Handy Cook Stove. Use it indoors or outside. Sizzling hot in 2 minutes. Heats Warm meal anywhere, anytime. Strong, reliable, inexpensive, guaranteed.

Write for special prices *and catalog*

AKRON GAS LAMP CO., 488 Gas Bldg., AKRON, O.

STEGER

The most valuable piano in the world

¶ A piano of true artistic worth is a companion whose personality becomes a part of our lives. The Steger Piano and Player Piano measure up to every demand of long-lived friendship. The value of a Steger will be proved again and again in the fullness of years.

¶ Steger Pianos and Player Pianos are shipped on approval to persons of responsibility. Write for Steger Style Brochure today.

STEGER & SONS
Piano Manufacturing Co.
Founded by John V. Steger, 1879.
Steger Building, Chicago
Factories at Steger, Illinois

PATENTS

IF YOU HAVE AN INVENTION which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

All communications are strictly confidential. Our vast practice, extending over a period of seventy years, enables us in many cases to advise in regard to patentability without any expense to the client. Our Hand-Book on Patents is sent free on request. This explains our methods, terms, etc., in regard to **Patents, Trade Marks, Foreign Patents, etc.**

If you are a reader of the

SCIENTIFIC AMERICAN

you are probably aware of the fact that it has a special appeal to the inventor. Each issue contains a description of a large number of recently patented inventions. Pending patent legislation as well as the most recent rulings of the Patent Office and the courts are considered in its columns.

MUNN & CO.

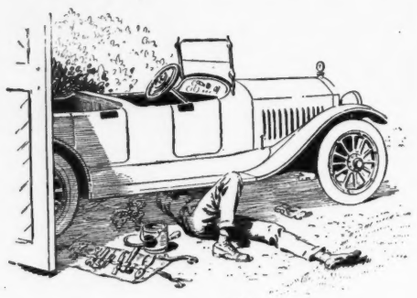
SOLICITORS OF PATENTS

683 Woolworth Building, New York
624 F Street, Washington, D. C.
Tower Building, - Chicago, Ill.

It's the Little Things about an Automobile that Make for Economy

By G. F. Collins

WHAT troubles occur most frequently on the road? Let us make a list of the ailments which most frequently afflict the automobile while it is serving our pleasure. This done, we will consider what the careful owner can do to eliminate them as far as possible. If we leave out of consideration skids and collisions, which are either unavoidable or the result of sheer carelessness or negligence, we have the following list of common troubles: Ignition trouble, carburetor trouble, broken rear axle, burnt-out engine bearings, slipping clutch, stripped transmission gears, universal joint troubles and stripped differential gears. It is quite a formidable list, and nine out of ten owners, whose cars are towed into garages, can charge the resulting expense to one of the above items.



"Know your car" is the slogan of the modern motorist. A well groomed car means money in your pocket

"Cleanliness is next to godliness," but as applied to the automobile, cleanliness comes first and is all-important. Each part of your car will operate better, wear longer and give less trouble if it is kept clean and free from grit. Careful cleaning also involves inspection, for the two go hand in hand. When you clean the dirt out of corners with kerosene and a brush you may discover that an oil pipe which feeds an important bearing is broken; a loose taper pin in the pump or magneto shaft; a missing grease cup and countless other things. During the writer's experience of fourteen years he has yet to see an owner, who kept the working parts of his car absolutely clean, experience serious trouble on the road.

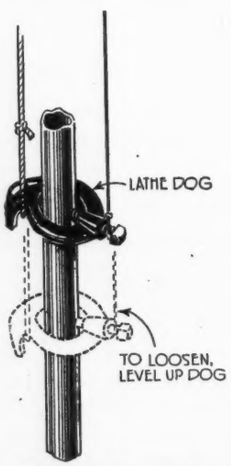
Returning home after a long ride, the first thing you should do is to remove the dust. During the entire trip the carburetor has been drawing dust-laden air into the hot air tube. Clean it out and keep it clean.

When you fill the tank, strain the gasoline. The man at the gasoline station may tell you that it isn't necessary, but strain it just the same. Clean the vacuum tank strainer and examine the pipes to see if they are being chafed by rubbing on the chassis. Be careful when you wash the car. Some carburetors are so placed that there is danger of filling them with water.

Perhaps you would like to know how all this attention to detail can prevent the unexpected breaking of a rear axle. What causes a rear axle to break? For one thing, it is bad for the rear axle and for everything else to jerk along on three cylinders if you should be running on four. If the clutch does not engage properly, you are throwing a sudden load on the axle, a sudden shock which has a tendency to twist it off. The writer knows of many cases in which the axle has been broken by letting in the clutch suddenly in an effort to get out of a mudhole or a snow bank. Don't neglect the clutch. It can be kept soft and smooth in operation without slipping, and then, when you engage it, there will be no sudden shock. Save the car all you can from jolts and jars by using the brakes.

Universal joints fairly cry for grease and attention. Unless you heed the warning at once, it is too late to save them, for they are worn and will ever after rattle. Invest in a creeper or hunt up some old clothes and go for a tour under your car. It isn't necessary to do it very often, but it is a great deal better to explore the under part of the car at your leisure in the garage than under compulsion on the road.

You will be amply repaid for your trouble, and, while cleaning and adjusting the universal joints under your car, seize the opportunity to put some oil on the brake toggles and equalizer.



Lowering or raising pipes into and out of holes is made easy by this contrivance

Pulling Pipe with a Lathe-Dog

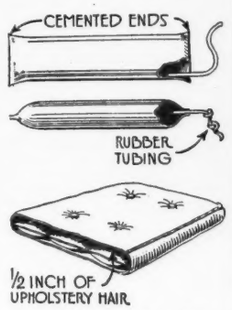
A GOOD and sure way of drawing pipes, rods, or poles out of inaccessible places, or to lower them, is to use an ordinary lathe-dog slipped down over the piece of pipe. A rope sling passed over the hook furnishes the necessary equipment attaching.

While hauling up, or lowering, the set-screw of the dog, combined with dog's cramped position, prevents slipping. It is merely necessary to level the dog and it will be released.

An Old Inner Tube Makes a Pneumatic Seat

ON an occasion when it was found impossible to purchase a pneumatic cushion of the size required for a certain purpose, a substitute was devised in the following way:

Three sections 30 in. long were cut from a 4½-in. old inner tube and the ends cemented together with a small rubber hose thrust into each piece of tubing as shown in the sketch. After leaving them for a day and night the tubes were inflated and the end of the rubber hose tied into a knot. All three sections were uniform in size and measured about 2½ in. thick. A canvas cover was made which inclosed them, and a 1-in. layer of upholstery hair was placed above the tubes inside the bag. This is a very easy cushion to sit or ride upon and it can be made at very little cost.—H. W. TAPLEY.



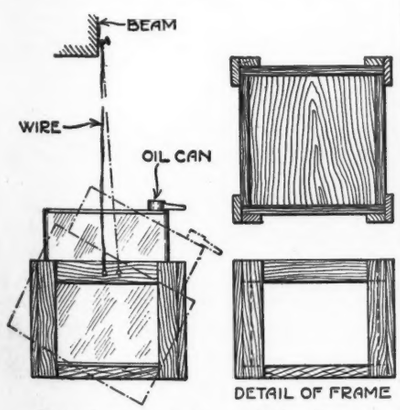
Another use for the old inner tube is to convert it into a comfortable seat

Save Your Strength when Tipping Oil-Drums

THE five-gallon container in which standard automobile engine oils are sold is clumsy and heavy to handle when small cans, measures, etc., have to be filled.

This clumsiness can be remedied by a simple device that you can readily make yourself.

Make a wooden frame to hold the can and suspend the frame either by small chains or wire from a beam in the garage, as shown in the illustration. The base of the frame is a square board the size of the bottom of the oil tin.



By this method the unwieldy oil-can is made to give up its contents easily

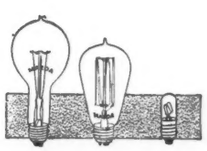
This apparatus provides a practical tipping device.—CHARLES E. WILLEY.

MAZDA

"Not the name of a thing, but the mark of a service"

MAZDA is the trademark of a world-wide service to certain lamp manufacturers. Its purpose is to collect and select scientific and practical information concerning progress and developments in the art of incandescent lamp manufacturing and to distribute this information to the companies entitled to receive this service.

MAZDA Service is centered in the Research Laboratories of the General Electric Company at Schenectady, N.Y. The mark MAZDA can appear only on lamps which meet the standards of MAZDA service. It is thus an assurance of quality. This trademark is the property of the General Electric Company.



A MAZDA Lamp for every purpose

4647

RESEARCH LABORATORIES OF GENERAL ELECTRIC COMPANY

SUPERIOR SINCE 1904
Over 100,000 in Use
Mostly sold through recommendation
For Personal Desk or General Office
It checks mental calculations. Buy through your stationer. Write for 10-day Trial Offer
P. E. Ganeher, A. A. M. Co.
148 Duane St., New York
Canadian Agency
Agents wanted
Golden Gem PORTABLE Adding Machine $12
Multiplies—Subtracts

$3 AND $4 A month WILL BUY
A Beautifully Reconstructed
TYPEWRITER
With Every Modern Writing Convenience
WRITE TODAY FOR ILLUSTRATED CIRCULAR
Explaining Try-Before-You-Buy Plan
HARRY A. SMITH, 306-218 North Wells St., Chicago, Ill.

$1 a Week pays for the Black Beauty

Don't buy an ordinary bicycle. Get the Black Beauty—most magnificent wheel in all cycledom. *Built in our own factory and shipped direct; wholesale price.* No middlemen's profits.

18 Exclusive Features

Get our Catalog; select your model. 20 *Styles*. We ship at our own risk. Keep or return. No waiting to save up money. *Months* to pay—small amount on acceptance, then $1 a week. *5 year guarantee.*

Sundries Get our factory prices first. Lowest in the country. TIRES, lamps, horns, etc. Everything for cyclists. Free Sundries Catalog.

HAVERFORD CYCLE CO.
Dept. C-67 Philadelphia

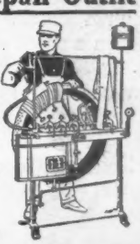
FREE Beautiful New Catalog in colors

AN EASY WAY TO MAKE MONEY

Don't be content to plod along on a small salary. Be independent. Go in the tire repairing business. One man says "I made $60.00 the first day." Others average $200 to $500 a month. Very little capital needed. Jobs plentiful. Every motorist a possible customer. No experience needed. We teach you.

SHALER Tire Repair Outfit

Improved Wrapped Tread Method Used by Tire Manufacturers



Does as good work as the big high priced vulcanizing outfits. A boy can use it. It's the only vulcanizer that has Automatic Heat Control, and can't undercure or overcure a tire. Requires no watching or regulating.

FREE Book

"How to Open a Tire Repair Shop." It tells how to make big money. Don't delay. Write quick.

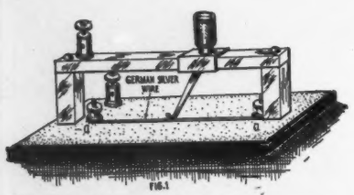
C. A. SHALER CO.
2107 Fourth St. Wausau, Wisconsin

For the Radio Experimenter

Of especial interest to experimenters is the article on vacuum tubes beginning on Page 67 of this issue

Delicate Adjustment for Filament Rheostat

DIFFERENT vacuum detectors of the same make frequently require different adjustments of the filament rheostat to bring them to the most sensitive state for signal reception. While one tube may respond to signals



Supplementary rheostat for securing fine variations of battery current

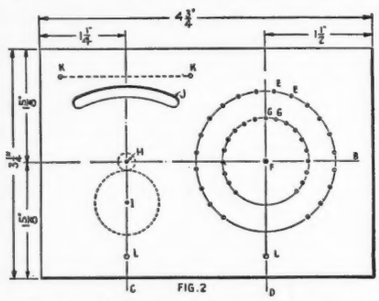
over a wide range of heating current, another will require a very delicate adjustment of the filament current to bring it to the critical point. It is often impossible to reach this critical adjustment with the standard battery rheostat, as it may lie at a point in the resistance wire between two consecutive turns. One method of overcoming this difficulty is to insert a smaller and more delicately adjustable rheostat in the battery circuit. It should have a total resistance equivalent to two or three turns of wire in the standard rheostat, and a reliable sliding contact which will vary the length of the resistance wire in the circuit by fractions of an inch. The coarse adjustment is accomplished with the standard rheostat. The delicate adjusting is done with the sliding contact rheostat.

The construction of such a supplementary rheostat is shown in Fig. 1. A 6-in. length of No. 30 30% German silver resistance wire is stretched between two battery bolts and nuts *A A* and a slider with a spring brass lever and silver contact is attached to make contact with the wire at any point of its length.

A complete rheostat with a delicate adjustment, neat in appearance, and which may be mounted on a panel has been constructed according to the directions which follow. It has given satisfactory service for several months and is still doing its duty.

Two small gears, having a ratio of about 10 to 1, are selected from an old alarm clock. A rectangle is drawn upon a sheet of paper 3¼ in. x 4¾ in. (Fig. 2). Lines *B*, *C* and *D* are drawn across the rectangle corresponding to the dimensions given. Using the junction *F* of *B* and *D* as a center, two circles are described having a radius of ⅝ in. and 1 in. Part of the larger circle is spaced off with a pair of dividers into 19 equidistant parts and the divisions which number 20 are marked as shown at *E E E*. Lines are also drawn from points midway between divisions *E E E* to the center *F* and their junctions with the smaller circle are marked as at *G G G*. The small alarm clock pinion is placed so that its center coincides with *H* at the junction of lines *B* and *C* and the larger gear placed in mesh with the small pinion so that its center lies on the lower half of line *C* as shown by dotted circles. Its center is marked on the paper at *I*. Using *I* as a center, two arcs *J J*, ⅛ in. apart, are described and their ends joined as shown.

Points *K K* and *L L* are also marked in the positions shown. A hard rubber base ⅜ in. x 3¼ in. x 4¾ in. is now marked, drilled and cut



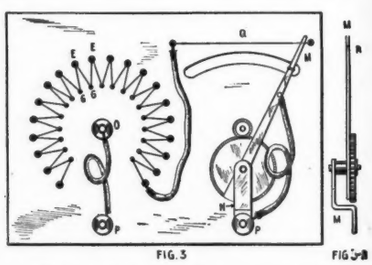
Pattern for laying off dimensions on front board of complete rheostat

ready for assembling from the rectangular plot as follows: The surplus paper is cut from the edges of the rectangle. It is then applied to the front of the hard rubber base, marked side out, so that their edges coincide. Points *E E E F H L* and *L* are pricked in the surface of the rubber with a sharp pointed instrument. The arcs *J J* are described upon the surface of the rubber by the use of a sharp pointed pen knife which is used to trace the lines by cutting through the paper.

The rectangle is then removed and a pin or needle forced through the paper at points *G G G K K* and *I*. It is then applied to the back of the rubber base, marked side in, so that its position relative to the points marked on the front is the same as when marking the front. Points *O G G K K* and *I* are located by the pierced holes and pricked on the back of the base. The material within the arcs *J J* is cut out with a coping saw. Holes ⅛-in. in diameter are drilled through the base corresponding to points *F H L* and *L*. Small holes are drilled through points *E E E*, to accommodate large headed brass tacks or brads (obtainable at the hardware stores) with a driving fit. The brass brads should be long enough to project ¼ in. on the rear side of the rheostat base. Points *G G G* and *K K* are drilled only part way through the rubber from the back, to receive smaller brass brads with a driving fit, and point *I* is drilled to act as one bearing for the shaft of the larger gear.

The assembled instrument is shown back and front in Figs. 3 and 4. The large brass tacks are forced into holes *E E E* from the front until their heads are flush with the surface. Brass brads are driven into holes *G G G* at the rear and a piece of No. 30 German silver wire is strung back and forth between the brads and projecting tacks as shown in the drawing. A turn or two is taken around each of the brads and tacks during the process of stringing, and the contacts soldered. A hard rubber knob, switch lever and short length of ⅛ in. brass rod are assembled in the usual manner and placed in position as shown at *O*, Figs. 3 and 4, so that the switch lever makes contact with the heads of the brass tacks upon turning the knob. It is held in place by a spring washer and nut at the rear of the base. A flexible lead is soldered to the shank of the switch at the rear to a terminal *P* fastened to the base through hole *L*. This completes the coarse adjustment member of the rheostat.

The fine adjustment member consists of a double contact lever *M*, which is attached to the larger gear



Rear view of the completed rheostat's front board and parts

and which makes connection with a length of German silver wire *Q* stretched between two brass brads driven into holes *K K*. The construction of the contact lever *M* is shown in Fig. 3 *A*. Two strips of flat spring brass are soldered to the large gear so

that both will press upon the resistance wire represented at *R*. The gear and its lever are held in place at the rear of the rheostat by a piece of strip brass *N* which is fastened beneath a terminal *P*. This strip brass piece *N* acts as one bearing for the shaft of the gear.

The other bearing is the hole drilled in the rubber base at *I*. The shank of the adjustment knob *S* is inserted in the hole at *H* and the small pinion soldered to it at the rear of the base. The larger gear and contact lever are mounted in place, and a flexible lead soldered to lever *M* and a terminal P. A turn of wire is taken around lever *M* at point *T*, to which it is soldered, and the free end passed through the slot within the arcs *J J*. It is bent down on the front side, and served as an indicator which moves across a scale *V* inscribed in the base.

A flexible lead is soldered between the straight length of resistance wire and the last tack of the multiple point

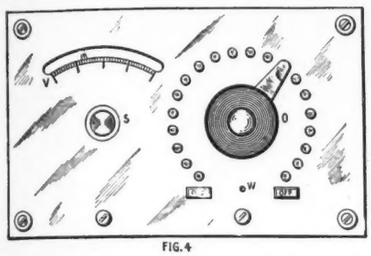


FIG.4

Front view of completed rheostat—at left, fine adjustment; at right, the coarse

switch, as shown in Fig. 3. A pin *H* is driven into the base to prevent the lever from being turned in the wrong direction at the start. Four holes are drilled through the corners of the base to facilitate fastening the instrument to a panel, and the words "on" and "off" are inscribed in the base.

In operation the multiple point switch-knob is turned until a hissing is heard in the receivers. It is then turned back one point and the adjustment knob *S* turned to the left until the filament reaches the critical adjustment.

Hearing of the War via Radio Aerial

GODFREY ISAACS, managing director of an English radio company, recently related how London heard Berlin send out pronouncements regarding the war:

"The first message of the war we received said: 'War declared against Russia!' Then followed, after an interval of two days, 'War declared against Russia and France!' Two days later we heard, 'War declared against England. All ships make for neutral ports.'

"The last message we received at five o'clock in the morning, saying, 'Armistice signed. All hostilities to cease at eleven o'clock.' This message came from French headquarters on November 11."

THE ONLY VACUUM TUBE WHICH AMATEURS CAN USE

Fleming Pat. No. 803684
De Forest Pat. Nos. 841387-879532

Agreements recently effected have made vacuum tubes available for experimental use. The Marconi V. T. is the only vacuum tube, or audion, which may be sold to amateurs, laboratories, schools of instruction and experimenters.

MARCONI V.T.

$7.00 each

Standardized base . . $1.50 additional

A highly developed, all-around tube for use as a detector and amplifier in wireless communication. It has practically the same electrical constants as the tube used by the Allied armies and navies throughout the war in continuous wave transmission and reception. The terminals of the elements of the tube are brought out to a 4-prong standardized base, fitting into the standard four-contact bayonet sockets.

Filament current, 0.7 ampere. Filament potential, 4 to 6 volts.
Plate potential, 20 to 60 volts for reception.

For lighting filaments a *lead* storage battery is preferable because of its constancy of voltage. Ordinary dry cells or flashlight batteries may be used to provide the plate voltage.

The approximate operating life of the MARCONI V. T. is 1,500 hours.

Delivered postpaid in special container insured against breakage to any address upon receipt of purchase price.

COMMERCIAL DEPARTMENT

Marconi Wireless Telegraph Co. of America

Sole distributors for
De Forest Radio Telephone & Telegraph Co.

Room 1868 Woolworth Building, 233 Broadway, New York

Big Money for Boys!

Learn
ELECTRICITY

There is a wonderful opportunity right now for boys who like electricity. Boys who are ambitious and will train themselves in spare time can step into good positions and get experience that will give them a real start toward success in life. Good salaries are offered with rapid promotion.

For 28 years the International Correspondence Schools have been training boys for success in electricity and over 200 other subjects. They will help you prepare right at home for a position in the line of electrical work you like best—or in any other work that appeals to you. Thousands of boys, through I. C. S. training, have stepped into fine jobs, but never were opportunities so great as now.

Let the I.C.S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least, and it will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon *now*.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 7649, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

ELECTRICAL ENGINEER	SALESMANSHIP
Electric Lighting and Rys.	ADVERTISING
Electric Wiring	Window Trimmer
Telegraph Engineer	Show Card Writer
Telephone Work	Sign Painter
MECHANICAL ENGINEER	Railroad Trainman
Mechanical Draftsman	ILLUSTRATING
Machine Shop Practice	Cartooning
Toolmaker	BOOKKEEPER
Gas Engine Operating	Stenographer and Typist
CIVIL ENGINEER	Cert. Pub. Accountant
Surveying and Mapping	TRAFFIC MANAGER
MINE FOREMAN or ENG'R	Railway Accountant
STATIONARY ENGINEER	Commercial Law
Marine Engineer	GOOD ENGLISH
Ship Draftsman	Teacher
ARCHITECT	Common School Subjects
Contractor and Builder	Mathematics
Architectural Draftsman	CIVIL SERVICE
Concrete Builder	Railway Mail Clerk
Structural Engineer	AUTOMOBILE OPERATING
PLUMBING AND HEATING	Auto Repairing
Sheet Metal Worker	Navigation
Textile Overseer or Supt.	AGRICULTURE
CHEMIST	Poultry Raising

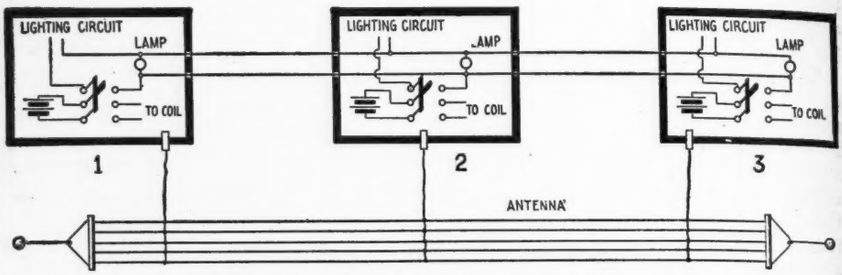
Spanish
French
Italian

Name_____
Present Occupation_____
Street and No._____
City_____ State_____

Canadians may send this coupon to International Correspondence Schools, Montreal, Canada

One Antenna Serves Three Stations

By K. M. Coggeshall



Three experimenters erected a tall aerial for their joint use by combining forces after the above plan. The switches and signal lamps shown kept them from interfering

EACH of three neighbors had a small sending and receiving outfit. With the individual antennæ messages could be received only from a limited distance. Consequently they tore down their old antennæ, and built a single large one about 75 ft. high and stretching across the three yards. Each then connected his individual station to the antenna, and, much to his satisfaction, found that his instruments picked up many long distance stations. Thus each had the advantage of an aerial with large radiating surface, at only one-third the cost. Of course it was necessary to see that the insulation at each station was perfect before attempting to operate any sending apparatus.

Immediately another problem presented itself. Suppose one station started to send while another station was receiving? The result might prove disastrous to the delicate receiving outfit, as well as dangerous to the receiving operator. The following signal system was therefore devised.

At each station, instead of the two-pole knife switch which formerly controlled the power circuit to the sending coil, a three-pole switch was inserted. Next, a line of two weather-proof insulated copper wires was run between the three stations. Directly on front of each controlling power switch was placed an incandescent lamp, the globe being stained red. This lamp was then connected in parallel with the inter-station line, as shown in the wiring diagram. The light being connected to the house lighting mains (or to a battery system) through the extra pole on the switch, the lamps in all the three stations would light as soon as power was thrown on.

Thus if station number 1 started to send, its operator would throw the power switch. This lighted the red lamps in stations 2 and 3. If either 2 or 3 were receiving they would immediately disconnect the antenna and wait until 1 had finished and the lamps went out. While this system had certain small disadvantages its good features completely outweighed them. Care must of course be taken to see that the lighting lines do not become cross-connected through the power switches. Small fuses should be placed in the leads from the lighting mains, for further protection.

Hearing German Wireless Stations Indoors

THE statement has frequently been made in current technical publications, that in order to receive wireless signals at a wavelength of about 10,000 meters, such as is used by the large transatlantic stations, an antenna at least 500 ft. long is required. The writer has found that such is not the case. Using a small indoor antenna, with the apparatus described in the following article, the writer has been able not only to hear, but when the conditions were reasonably favorable, to read complete messages from the large German station at Eilvese, Germany, almost any morning between seven and twelve o'clock. The station used by the writer was located at East Orange, N. J., and of course very strong signals were obtained from stations on this side of the Atlantic, such as Sayville and Tuckerton, when they were sending at a wavelength of about 10,000 meters.

The antenna referred to above was composed of 4 No. 19 single cotton covered copper wires about 35 ft. long and spaced about 15 in. apart. These wires were attached to the rafters just underneath the roof of a 2½ story frame house. No special precautions were taken to insulate this antenna, which was intended for receiving only, the wires being tied directly to the rafters. The direction of the aerial was approximately east and west. The lead-in wire was taken off from the east end of the aerial and carried down to the instruments on the second floor.

A regenerative oscillating audion circuit, which is shown in the diagram, was used for this work. This circuit will be recognized as one form of the well known Armstrong "heterodyne" circuits which have proved so efficient for long distance work.

In order to load such a very small antenna up to a wavelength of about 10,000 meters, a large loading coil is,

Progressive Radio Apparatus

To what reasons can the popularity of De Forest Radio Apparatus be attributed?

Is it because of its consistent performance, excellent workmanship, materials, low prices?

These would account for it partly. The real reason must lie in the fact that we have always been in the van. Design and system employed have been so far in advance of others as to overshadow our rivals.

The De Forest Company is one of the recognized successes in the radio field. Our success has been progressive—more than merely financial, because we give better service—more for your dollars—most modern apparatus—than you can obtain elsewhere.

We do not aim to sell the most radio apparatus—only the best. Quantity is a secondary consideration.

We were the first to produce the audion amplifier and the oscillion undamped wave transmitter, and its popularity is attested by its wide use.

Our latest productions, the Honey Comb Coils, Unit Set, Coil Mountings, Two Step Amplifier and Audion Control Box have been greeted with enthusiastic demand far exceeding our expectations.

The Unit Receiver fills the demand for a really efficient receiver for any and all wave lengths of any preferred circuit and design without the usual costly cabinet and expensive assembly.

We have been literally swamped with orders, so do not feel surprised when your dealer tells you it will be necessary to wait a few weeks before you can get delivery.

By placing your order now you will avoid the greater congestion in our factory when the purchasers of this meritorious apparatus of novel design begin enthusiastically recommending it to their friends.

DE FOREST RADIO TEL. & TEL. CO.
1415 Sedgwick Avenue New York City

SMOOTH-ON HOUSEHOLD CEMENT STOPS LEAKS

Easy to apply as putty—lasting as iron. Repairs leaks, cracks, and breaks at little cost. Get a Can of SMOOTH-ON IRON CEMENT NO. 1 for every Household and Auto repair. Stops Auto Radiator leaks. 25c. and 50c. at Hardware stores. Write for interesting Booklet showing dozens of uses.

1 lb. 50c
6 oz. 25c

SMOOTH-ON MFG. CO.
Jersey City, N. J., U. S. A.

REPAIRS CRACKS

Earn $35. to $100. WEEKLY

You can make $35.00 to $100.00 a week. I want hustlers, money-makers, to work with me, to advertise, sell and appoint agents. Biggest thing in years. City conveniences without plumbing. Used in any room. Sells on sight. **Demonstrating tub furnished.** Folds small, self-emptying, non-leakable. Guaranteed 10 years.

AGENTS MAKE SALES EASILY

Two sales daily means $60.00 a week. Leggett, Ohio, "Worked two hours, took two orders, profit $10.00." Hayhurst, Nebr., "Took 11 orders in 4½ days—profit $55.00, ordered 12 more subs." Manning, Iowa, "Sold 10 tubs in one day—profit $50.00." DeHut, Nebr., "Sold 12 tubs in three days—profit $60.00." And hundreds of others making big money. 70 per cent of homes have no bath tubs. Experience and capital unnecessary. Credit given to the right man. Get full particulars and "special plan" all Free.

M. S. Robinson, Pres., THE ROBINSON CABINET MFG. CO.
5011 Factories Building TOLEDO, OHIO

USE HB BALL BEARING ELECTRIC MOTORS

BIG SAVING IN POWER BILLS EVERY MONTH

HB Ball-Bearing Motors furnish ideal power at lowest cost for factory, machine shop or garage. All power waste eliminated. Amply designed, absolutely trouble-proof, economical and reliable. Highest efficiency in daily service. Bearings need refilling only once in three months, require almost no attention.

$20.00 Brings You Any HB Motor. Balance on Easy Terms. Size to 15 h.p. Choose to Suit Your Needs.

If in doubt about requirements, write our service department. Get their expert advice—FREE. Simply state what machinery to be run and type of current available. We plan your power system for best results at least cost. Pin this ad to your letterhead and mail TODAY for full information. Ask also about HB Battery Chargers, Generators, etc.

HOBART BROTHERS COMPANY
Box 582 Troy, Ohio
Successful Manufacturers Since 1898

AGENTS 500 % PROFIT

Gold and Silver Sign Letters

For store fronts, office windows and glass signs of all kinds. No experience necessary. Anyone can put them on and make money right from the start.

$30.00 to $100.00 a Week!

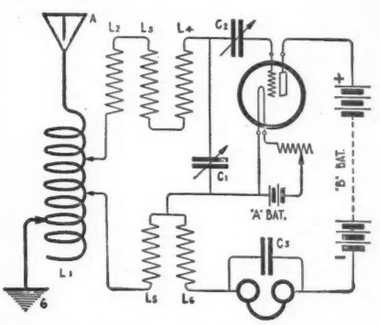
You can sell to nearby trade or travel all over the country. There is a big demand for window lettering in every town. Send for **Free Samples** and full particulars.

Liberal Offer to General Agents.

METALLIC LETTER CO., 433A N. Clark St., Chicago

of course, required. The loading and coupling coil L (see diagram of connections) used by the writer was composed of a single layer of No. 28-gage wire wound on a cylinder 12 in. in diameter and 18 in. long. The winding was carried to within ½ in. of each end of this cylinder. The form for this coil was made by winding several layers of heavy paper on a light wooden framework. This, as well as all other coils described in this article, was left dry, no shellac or any other kind of varnish being used after the winding was completed. Taps were taken off this coil every 2 in. and carried to a multiple point switch. This was found to give sufficiently close adjustment. Such a very large coil as this, wound with fine wire, necessarily has a high inductance and resistance and therefore the tuning may not appear to be very sharp.

As can be seen in the diagram, the secondary circuit was directly connected with this one large coil, no inductive-coupler being used. One of the 2-in. sections of coil L was found to give about the right degree of coupling.



Regenerative audion circuit used to get signals from overseas with simple indoor aerial

The secondary loading inductance consisted of three coils L_2, L_3 and L_4, each composed of a single layer of No. 28-gage wire wound on a cardboard cylinder 4 in. in diameter and 10½ in. long. These coils were wound to within ⅜ in. of each end of the cylinders. No taps were found necessary for these coils. It would of course be possible to use a single long coil in place of these three short ones—the writer simply found it more convenient to make the three short coils.

Coils L_5 and L_6 serve to couple the "plate" and "grid" circuits together and render the system regenerative. Coil L_5 was wound on a cardboard cylinder 4 in. in diameter and 7 in. long. Coil L_6, which was the same length as L_5, was made just small enough to slide within L_5. Both cylinders were wound to within ⅜ in. of their ends with a single layer of No. 28-gage wire. In connecting these two coils together care should be taken to connect them in such a way that, if direct current were to be passed through the two coils in series, the current would flow in the same direction in both coils.

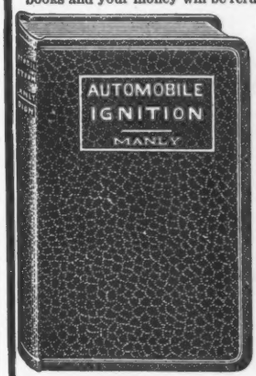
The secondary tuning condenser C was constructed by covering with tin-

FIT YOURSELF FOR THE BIG JOB

Don't hesitate any longer. There is a greater demand for trained men now than ever before—greater opportunities—bigger pay—more rapid advancement. It's training that counts now—accurate knowledge—a complete grasp of your trade.

Drake's Practical Mechanical Books

FOR HOME STUDY pave the way to the fat pay envelope. Written in non-technical language that any man can grasp. Send the price of any book listed below. We will send the books postpaid—you keep them five days—if not entirely satisfied return the books and your money will be refunded in full.



AUTOMOBILE BOOKS

Brookes' Automobile Handbook. 1919 edition, by L. E. Brookes, pocket size. Leatherette . **$2.00**

Automobile Ignition. By H. P. Manly. Pocket size. Leatherette . **$2.00**

Automobile Starting and Lighting. By Manly. 1919 edition. Pocket size. Leatherette . **$1.50**

The Ford Motor Car and Truck and Tractor Attachments. By Manly. Leatherette . **$1.50**

Automobile Catechism and Repair Manual. Pocket size. Leatherette **$1.25**

Practical Gas and Oil Engine Handbook. By Brookes. Pocket size **$1.50**

Traction Farming and Traction Engineering. Cloth . . . **$1.50**

ELECTRICAL BOOKS

Electric Motors, Direct and Alternating Cloth $1.00, Leatherette $1.50
Wiring Diagrams and Descriptions Cloth $1.00. Leatherette $1.50
Armature and Magnet Winding Cloth $1.00, Leatherette $1.50
Modern Electrical Construction Cloth $1.00, Leatherette $1.50

STEAM ENGINEERING

Swingle's Handbook for Steam Engineers and Electricians . . . . . Leather $3.00
Complete Examination Questions and Answers for Marine and Stationary Engineers . . . . . Leatherette $2.00

RAILWAY BOOKS

Locomotive Engineering . . . . . Leather $3.00
Locomotive Engine Breakdowns, with Questions and Answers . . . . Leatherette $2.00
First, Second and Third Standard Examination Questions and Answers for Locomotive Firemen . . . . . Leatherette $2.00

SHOP PRACTICE BOOKS

Sheet Metal Workers' Manual . . Leatherette $2.00
Sheet Metal Work and Pattern Drafting Cloth $1.50
Oxy Acetylene Welding and Cutting Cloth $1.00, Leatherette $1.50
Modern Blacksmithing . . . . . Cloth $1.00

PAINTING BOOKS

Scene Painting and Bulletin Art . . . Cloth $3.00
A Show at Show Cards . . . . . Cloth $3.00
Sign Painting . . . . . Cloth $3.00

CARPENTRY AND BUILDING

Modern Carpentry . . . . . 2 vols., Cloth $2.00
The Steel Square . . . . . 2 vols., Cloth $2.00
Wooden Boat and Shipbuilding . . . . . Cloth $1.50

GENERAL INSTRUCTION AND REFERENCE BOOKS

Elementary Chemistry, Self-Taught Cloth $1.00
Complete Courses in Civil Service . . Cloth $1.50
Practical Handbook for Millwrights Cloth $2.00

Just Out!

FRENCH Without a Teacher
SPANISH Without a Teacher
GERMAN Without a Teacher

By Professor Phillip Schuyler Allen, University of Chicago. An entirely new home-study series of modern foreign languages. Simplest, easiest-to-master language method ever devised.

French, Spanish or German, pocket size, cloth, each **$1.25**

Mail the Coupon NOW

Order on our five day money back plan.

FREDERICK J. DRAKE & CO.,
1003 Michigan Ave., Chicago, Ill.

Enclosed find ($. . . . .), for which please send me prepaid the books checked in this adv. (or list attached). It is agreed that I may return same in 5 days if not entirely satisfied, and money will be refunded in full.

Name. . . . . .

Address. . . . . .

DU PONT AMERICAN INDUSTRIES
Save Laundry Bills
VENONA
Non-wilting
The one stiff collar for summer. Snappy, stylish and neat. Perspiration-proof and instantly cleaned when soiled.
Challenge Cleanable Collars
save laundry dollars. A damp cloth and a little rub makes them instantly spic and span. For dress or business—hard work or play. All popular styles and half sizes. Ask your dealer or send 35 cents (and your style and size) for sample.
Ask for style book
THE ARLINGTON WORKS
Owned and operated by
E. I. du PONT de NEMOURS & COMPANY
Wilmington, Delaware.
DU PONT

Hero Safety Razor 35c

Same type as the best known $1 safeties. Wonderful value. Sent complete with one blade for 35c.
HERO BLADES—high quality steel, keen edges that shave and last. Also fit Star, Gem, Ever Ready.
Write for sample package, 3 for 15c.
Dealers write for prices
Hero Safety Razor Co.
260 Logan Street
Brooklyn, N. Y.
Complete Outfit 35c

Set in solid Gold
Set in Solid Gold
Send Your Name and We'll Send You a Lachnite
DON'T send a penny. Just send your name and say, "Send me a Lachnite mounted in a solid gold ring on 10 days' free trial." We will send it prepaid right to your home. When it comes merely deposit $4.75 with the postman and then wear the ring for 10 full days. If you, or if any of your friends can tell it from a diamond, send it back. But if you decide to buy it—send us $2.50 a month until $18.75 has been paid.
Write Today Send your name now. Tell us which of the solid gold rings illustrated above you wish (ladies' or men's). Be sure to send finger size.
Harold Lachman Co., 12 N. Michigan Av., Dept. C-120 Chicago

Be a Finger Print Expert

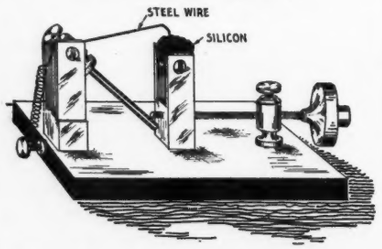
Police departments, factories, and industries everywhere are adopting this system of identification. Experts needed at once. You can train yourself in spare time at home. Write for details.
Free Book—Write Valuable and interesting book on finger prints sent absolutely free and prepaid. Also details of special limited offer. Write at once, while this offer lasts.
UNIVERSITY OF APPLIED SCIENCE
Desk C120 1772 Wilson Avenue, CHICAGO

Mathematics Made Easy

The Arcascope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes A TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, Etc. Only 85c postpaid. Order today before you forget.
Dept. U, L. J. LEISHMAN CO. Ogden, Utah

foil both sides of a flat piece of cardboard about 7 in. long and 2¾ in. wide. The two sheets of tinfoil were connected together and with one terminal of the condenser. This tinfoil covered piece of cardboard formed the movable element of the condenser and was arranged to slide between two other sheets of cardboard, of about the same size, which were covered on the inside with tinfoil. The tinfoil on the movable element was separated from that on the stationary element by several sheets of paraffined paper. The two sheets of tinfoil on the stationary element were connected together and with the other terminal of the condenser.

A Home-made Detector Stand Complete



Many amateurs still experiment with crystal detectors. Here is a novel and easily made stand. Materials readily available in any small shop are satisfactory and the resulting instrument is capable of exact adjustment. Wide experiment is possible

For the grid circuit a condenser C_2 of very small capacity is required. Such a condenser was constructed by covering with tinfoil a cardboard cylinder 1¼ in. in diameter and 6 in. long. This cylinder was arranged to slide within another cardboard cylinder, 1½ in. in diameter and 6 in. long which was covered on the inside with tinfoil. These two sheets of tinfoil were connected with the two terminals of the condenser.

For these two condensers, C_1 and C_2, air insulated, variable condensers of the rotary plate type, could, of course, be used if desired. With the two condensers described above very good results were obtained.

The telephone condenser C_3 may be almost any non-adjustable condenser of the type found in every wireless station. The writer used a fixed condenser of about .002 microfarads capacity which was made up of sheets of tinfoil and paraffined paper.

The telephones for this work should have a resistance of not less than 2,000 ohms per pair. The writer used a pair having a total resistance of 3,000 ohms with very good result.

The detector used was one of the usual De Forest tubular audions. For lighting the filament, a six-volt storage battery was found very satisfactory. In place of this storage battery dry-cells may be substituted if preferred. For battery "*B*" forty-seven small flashlight cells connected in series were used. This battery showed about 65 volts maximum, which was found to be none too high for the particular tube used.

The following settings of the variable elements of the above set, which were used by the writer for receiving the signals from Eilvese, Germany, should be helpful. It is, of course, understood that these settings are exactly correct only for the one antenna with which they were used. The correct values for any other aerial can be found only by trial; but it is believed that these will serve as a good starting point from which the correct settings for any other antenna can be more readily found.

The ground switch was set to include in the primary circuit all but the last section of coil L_1. Coil L_6 was placed entirely within coil L_5; that is, it was set for the maximum degree of coupling. C_1 was set for about ¾ of its maximum capacity and C_2 for ⅓ of its maximum. All of battery "*B*" was used.

In making adjustments for such a station as Eilvese, which sends on the continuous wave system, the fact should be kept in mind that such stations can be heard only when the receiving audion is oscillating. There are several simple tests which may be made to determine whether or not the audion is oscillating. One is to open and close the ground switch. If the audion is oscillating a distinct click will be heard in the 'phones.

Another test is to touch almost any bare conductor, in the secondary circuit, with the moistened finger. This test will also give a click in the 'phones if the audion is oscillating. When there is difficulty in causing the audion to oscillate, sometimes rapidly varying the capacity of C_1 will serve to start the oscillations. In some cases, opening and closing the "*B*" battery circuit will accomplish the same result. The writer has found that it is more difficult to cause the audion to oscillate when large values of C_1 are used. However, if the voltage of the "*B*" battery is sufficiently high it should be possible to cause the audion to oscillate even when the maximum value of C_1 is used.—MILLARD C. SPENCER.

Origin of the New Vacuum Tube Names

AS varieties of vacuum tubes have increased in number, new names have had to be coined to distinguish the different kinds. For instance, there is the "kenotron." This is a two-electrode tube, the first part of its name coming from the Greek *kenos*, signifying "empty space," a vacuum. *Tron* in Greek means "instrument." Hence *kenotron*, "empty space instrument," i. e., "vacuum tube." The "pliatron," a three-electrode tube, gets its name from *pleion*, "more." Hence it is a "more instrument"—an amplifier.

Rider Agents Wanted

In every neighborhood to ride and exhibit a sample RANGER bicycle furnished by us. Choice of 44 styles, colors and sizes in the famous Ranger line. Mead Rider Agents make big money in spare time hours—after school or work.

30 Days Free Trial

Is allowed on every RANGER bicycle. We prepay freight charges. If not pleased the trial costs you nothing.

Factory-To-Rider

We sell bicycles made in our own big factories DIRECT TO THE RIDER—giving you a superior product at greatly reduced cost. Save time, money and trouble by dealing direct with our great Factory organization. Satisfaction in every detail guaranteed or money promptly refunded.

TIRES Lamps, Wheels, parts and supplies at half usual prices are also fully described and illustrated in the big free Ranger Catalog.

SEND NO MONEY, but write us today for factory prices, liberal terms and if desired Rider Agents Plan.

EASY Payments Nine months to pay if desired—at a small advance over our special cash prices.

MEAD Cycle Company Dept. S109, Chicago

We want every man who shaves to write us for particulars about the Vibrating Electric Razor. No matter where you live, in the city or on the farm, the Electric Safety Razor will solve your shaving troubles.

VIBRATING ELECTRIC RAZOR CO.
Dept. 137, Omaha, Nebr.

Don't Wear a Truss

MR. C. E. BROOKS

Brooks' Appliance, the modern scientific invention, the wonderful new discovery that relieves rupture, will be sent on trial. No obnoxious springs or pads.

Brooks' Rupture Appliance

Has automatic Air Cushions. Binds and draws the broken parts together as you would a broken limb. No salves. No lies. Durable, cheap. Sent on trial to prove it. Protected by U. S. patents. Catalog and measure blanks mailed free. Send name and address today.

BROOKS APPLIANCE CO., 255B State St., Marshall, Mich.

$7.77

Springfield-Remington

Single shot rifle altered and refinished. Shoots cal. 30, model 1906 army cartridge. Weight 7½ lbs., total length 39 inches, U. S. Barrel 23½ inches Remington breech action, blued finish U. S. graduated sight. Price $7.77 plus war tax 78 cents. Cartridges $3.50 per 100 war tax 35 cents, packing charge 45 cents.

FRANCIS BANNERMAN SONS 501 BROADWAY, N.Y.

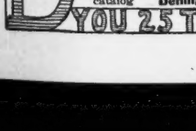
THE BOY ELECTRICIAN. Popular Plans of Electrical Apparatus for Work and Play with an Explanation of the Principles of Every-day Electricity. $2.00 *Postpaid.*
Popular Science Monthly, 225 W. 39th Street, New York

CLASS PINS-RINGS

DIRECT FROM FACTORY TO YOU
OUR NEW CATALOG WITH 600 OF THE LATEST UP-TO-DATE DESIGNS FREE.
C. K. GROUSE CO.
12 Bruce Ave., North Attleboro, Mass.

DENINGER WILL SAVE YOU 25 TO 50 DOLLARS

$40



BIG MONEY SAVINGS FOR YOU

Used and rebuilt motorcycles, single and twins, $25 to $100. Used bicycles, $5.00; tandems, $10. All machines guaranteed in good working order. New bicycles and motorcycles at Factory prices. You save dealers' profits. Motorcycle and automobile tires too, $3.00. Complete line of parts and supplies.

Send for catalog

Deninger Cycle Co., Rochester, N.Y.

New Radio Compass Stations and Their Calls

AMATEURS recently restored to their receiving apparatus can "listen in" intelligently on the new radio compass traffic if they are acquainted with the following information recently given out by the Government:

"The following harbor-entrance radio compass stations are now in operation for the purpose of furnishing positions to vessels within thirty miles of the entrance to the outer channel, and bearings to vessels within one hundred miles.

"Boston Harbor (NAD); New York Harbor (NAH); Delaware Capes (Cape May, N. J.) (NSD); and Chesapeake Capes (Virginia Beach, Va.) (NCZ); Gloucester, Mass., Deer Island, Mass., and Fourth Cliff, Mass., are radio compass stations taking bearings for Boston. Fire Island, N. Y.; Rockaway Beach, L. I., Sandy Hook, N. J., and Mantoloking, N. J., serve in this manner for New York. Cape May, N. J., Cape Henlopen, Del., and Bethany Beach, Del., do it for Cape May. Virginia Beach is served by Hog Island, Va., Smith Island, Va., and Cape Henry, Va. Cape Cod, Mass. (NAE), Nantucket, Mass. (NBS), Cape May, N. J. (NSD), and Cape Hatteras, N. C. (NDW) all operate individually and furnish bearings only to vessels within one hundred miles.

"Vessels desiring to obtain a bearing from compass stations which operate independently should call the station from which the bearing is desired, and request bearings by means of a conventional signal given below. Simultaneous bearings from two or more compass stations can be obtained by making the call include the other compass station desired. In doing this with independent stations, the station which is farthest north will supply the ship with its bearing first. The others will then follow in the order of their north-to-south or east-to-west geographical location.

"The following signals will be used: QTE? (What is my true bearing?) QTE (Your true bearing is .... degrees from ..... radio compass station.) QTF? (What is my position?) QTF (Your true position is lat.... long.....).

"The radio compass station (or compass-control station for harbor-entrance compass stations) will answer requests for bearings and positions in the customary manner of answering calls, and will follow their call letters with K if they desire to take the bearing at that time, QRX if they desire the vessel to stand by, or other abbreviated signals authorized by international regulations.

POPULAR SCIENCE MONTHLY will presently run an extended article, taking up present radio-compass stations, their mode of operation, and uses.

Don't Lose Your Grip!

STRONGFORT
The Perfect Man

Are things slipping away from you — everything worth while in life? Is your health going, your vitality ebbing away, your grasp on your work or your business lessening? *Don't let yourself get any worse.* The scrap-heap is the ONLY end to the toboggan you are on. You'll get worse rapidly, if you don't get better; you will slip faster and faster, until you land in the useless, hopeless army of broken-down, wornout men.

GET HOLD OF YOURSELF AND YOUR JOB

STOP—look the facts in the face—and ACT. Take steps right now, before it is too late, to get off the slippery incline you are on. Rid yourself of the constipation, indigestion, biliousness, headaches, devitalizing habits, poor memory, rheumatism, or other chronic ailments that are dragging you down. You can't succeed with those millstones hanging about your neck. You can't advance in your business or your work. You can't be happy yourself, or make your wife or your children happy, while you are tormented with internal troubles, you can't even become the father of healthy, happy children, who will be a joy to you and your wife, unless you

MAKE YOURSELF A REAL MAN

Don't feel that there is no help for you—that your ailments or bad habits have got a grip on you that can't be broken. *You can get rid of them;* you can knock them out; you can become well and strong and fit and fine and vigorous again—*if you will only go about it the right way.*

Don't think the nostrums described in patent medicine ads will do the business. Pills, powders and potions never made a real, red-blooded MAN. Don't be led aside by quack promises. The ailments that are handicapping you are only *symptoms* of your trouble, as every reputable physician will tell you. The only way is to DIG DEEP—get at the CAUSE of them—cure that, and the ailments resulting from it will disappear.

STRONGFORTISM

Strongfortism is Nature's way of cleaning up the system, eliminating disorders and upbuilding body and mind. Strongfortism consists simply of living Life as it ought to be lived—and thereby getting the greatest enjoyment out of it. Strongfortism has made thousands of weak, ailing, discouraged, almost hopeless men healthy, strong, vigorous, MANLY, and is keeping them in that condition. Strongfortism will show you how to dig out the root of your trouble, cast it out and become a normal healthy man again. Strongfortism will show you how to strengthen every vital organ; build up your muscles, internal as well as external and your mind, enrich your blood, acquire the pep and enthusiasm of youth—*get back the manhood you have lost.*

SEND FOR MY FREE BOOK

My life has been spent in studying *Nature's* methods of Upbuilding Men, and they are set forth in plain, man-to-man talk in "**Promotion and Conservation of Health, Strength and Mental Energy.**" I tell you in it just how I built myself up into the strongest man in the world. I tell you how my pupils in every part of the world are ridding themselves of their ailments and building themselves up into strong, healthy, *successful* men. What they have done and are doing, YOU can do. And you can do it without investing in any expensive gymnastic apparatus, in the privacy of your own bedroom if you like.

Fill out the coupon NOW—DON'T WAIT—and send for a copy of that book. You'll find it's worth big money to you—AND IT'S FREE. Just enclose three 2c stamps to cover packing and postage, and I'll mail you a copy at once, together with a special letter on the points you are particularly interested in.

LIONEL STRONGFORT
Physical and Health Specialist
1017 Strongfort Institute, NEWARK, N. J.

▪▪▪▪CUT OUT AND MAIL THIS COUPON▪▪▪▪

Mr. Lionel Strongfort, Newark, N. J.
Dear Strongfort:—Please send me your book "**PROMOTION AND CONSERVATION OF HEALTH, STRENGTH AND MENTAL ENERGY,**" for postage of which I enclose three 2c stamps to cover mailing expenses. I have marked (X) before the subject in which I am interested. (1017)

..Colds	..Insomnia	..Weaknesses
..Catarrh	..Short Wind	..Gastritis
..Asthma	..Flat Feet	..Heartweakness
..Obesity	..Stomach Disorders	..Poor Circulation
..Headache	..Constipation	..Skin Disorders
..Thinness	..Biliousness	..Despondency
..Rupture	..Torpid Liver	..Round Shoulders
..Lumbago	..Indigestion	..Lung Troubles
..Neuritis	..Nervousness	..Increased Height
..Neuralgia	..Poor Memory	..Stoop Shoulders
..Flat Chest	..Rheumatism	..Muscular Development
..Deformity (describe)	..Bad Habits	

NAME.....
AGE.....OCCUPATION.....
STREET.....
CITY.....STATE.....

Adventures of the
Auto-Wheel Coaster *Club*

HOW THE AUTO-WHEEL HELPS AT CAMP.

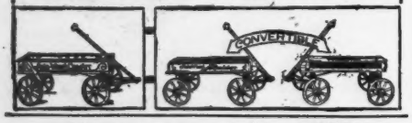
——First the long hike, with the Auto-Wheels carrying the heavy loads—tents, and chow, and fishing tackle, and all the rest.

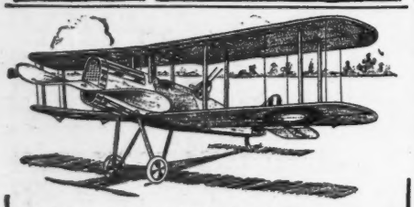
——And when we pitched camp the Auto-Wheels did a man-sized job hauling away rubbish from the camp area, and bringing up firewood. Jim, the Club Captain, bossed the job, and camp was ready in forty minutes.

——We all wore our Club caps—the kind all Auto-Wheel Club members get free by writing to the Buffalo Sled Company for details.

BOYS: If you want to share the fun of the Auto-Wheel Coaster Club, write for booklet showing Auto-Wheel Coaster and Auto-Wheel Convertible Roadster. *A Free Felt Pennant* goes with this handsome booklet.

THE BUFFALO SLED CO., 157 Schenck Street,
In Canada: Preston, Ont. N. Tonawanda, N. Y.





Build and Fly This Model of the Famous
DE HAVILLAND
De H—4
Battle Plane

Here's a new IDEAL Model Aeroplane—a faithful duplicate of the war-famous Battle Plane that downed the enemy over the battlefields of France. This new IDEAL Model is in every detail a practical, 3-ft. copy of the original. Has oval aluminum radiator, veneer cockpit and fuselage, aluminum top and bottom engine cowling, hand carved propeller, ball-bearing propeller shaft and rubber-tired disc wheels. Guaranteed to fly from the ground. Miniature gun mounts and guns can be made and mounted on the rear cockpit. Build one; it's easy! IDEAL Accurate Scale Drawing, including building and flying instructions, show any bright boy how to do it.

Plans and Instructions
for any of these 'planes sent postpaid

DE HAVILLAND BATTLE PLANE	**35c**
Curtiss Military Tractor	25c
Bleriot Monoplane	25c
Nieuport Monoplane	25c
Taube Monoplane	25c
Cecil Peoli Racer	25c
N.C.-4 (ready August 15th)	50c

Advance Orders now booked for N. C.-4 Plans

IDEAL Model Aeroplane Construction Outfits containing all parts and materials needed to build these Model Aeroplanes are sold by Leading Toy, Sporting Goods and Department Stores. Ask for them at your store.

IDEAL Model Aeroplane Catalog
48 pages. 5c. Postpaid.

IDEAL AEROPLANE & SUPPLY COMPANY
Cor. Houston and Wooster Sts., New York City

Send for a Complete Catalogue of

MASONIC BOOKS
Jewelry and Goods

REDDING & CO.
Publishers and Manufacturers

Dept. S 200 Fifth Avenue New York

Health? Take Turkish Bath at Home

—ONLY 2 CENTS

Physicians are abandoning drugs for this new treatment. If your mind or body is tired, or you have rheumatism, blood, stomach, liver, kidney and skin troubles, open your pores, and feel the rapid change in your condition, at cost of 2c a bath. **The Robinson Bath Cabinet** is the only scientifically constructed bath cabinet ever made for the home. **Great $2 Book Sent FREE**—"The Philosophy of Health and Beauty." Write today. *Agents wanted.* **ROBINSON MFG. CO., 991 N. Twelfth St., TOLEDO, OHIO**

SECURE A MOTOR-CYCLE AT A LOW PRICE
by putting a **RELIABLE STEFFEY MOTOR**

on your wheel. Easy to attach. Costs less to run than an expensive motor-cycle. If you write at once you can secure one at a low factory price. Send stamp.
STEFFEY MFG. CO. Dept. S, 5025 Brown St., Philadelphia, Pa.

A Variometer for Radio Apparatus

By Raymond Francis Yates

WITH the present tendency to reduce sliding contacts in radio equipments, the variometer is finding wide and profitable use as a means for changing the inductance values of the primary circuit in receiving outfits. The average amateur is surprisingly ignorant of both the use and operation of this simple piece of apparatus, and yet it can be used with success in any station.

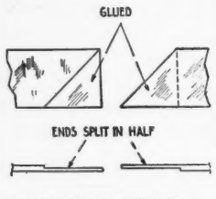


Fig. 1. Good joints in the cardboard improve appearances greatly

The operation of a variometer is very simple, being based on one of the most elementary laws of induction. If two excited coils, each containing the same amount of wire, wound in opposite directions, are placed in proper inductive relationship (one inside the other, as in the case of the variometer) to one another, the value of inductance of the whole unit will be practically zero. This is because the coils are in magnetic opposition and if means is provided for changing the plane of one of the coils, the value of inductance may be progressively changed as the coils approach magnetic attraction or as their windings come into a position where they will be in the same direction. By this means it will be seen that the primary circuit can be brought to a point of resonance with a minimum of sliding contacts. When a variometer is used, it will be found that four or five taps on the primary of the receiving transformer are sufficient, as the variometer is capable of giving very fine adjustment on intermediate values which compensate for the coarse variation of the circuit made by other means.

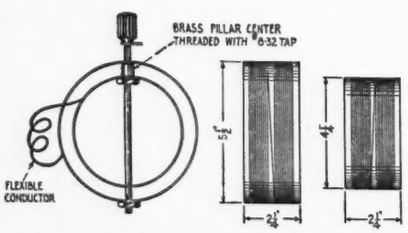


Fig. 2. At left, connection between coils is shown; at right, dimensions of the coils

The following lines describe the construction of a variometer for general use. Two tubes are made from heavy cardboard, one being 4¼ in. in diameter and the other 5½ in. in diameter. Both are made 2½ in. wide. The proper method of making a joint in the tubes is shown in Fig. 1. To put the cardboard in a workable condition it should first be soaked in water and then bent into shape. After the tubes are dried and glued into position they are both given a coat of show-card ink (black) which gives them a very beautiful finish. Both tubes are wound in opposite directions with No. 26 green silk-covered wire. The method of winding is shown in Fig. 2.

It is very essential that the same amount of wire be contained on each of the tubes—that is, to a reasonable degree of accuracy. This can be accomplished by means of a very simple calculation. Assuming that we have 60 turns wound on the large coil and the circumference of the coil is 17.25 in., there will be 17.25 x 60, or 1035 in. on the coil. With the circumference of the small coil 13.35 in., we have:—13.35 x 78, or 1041. After the coils are wound they are given a coat of white shellac which has been diluted with alcohol. This is essential to keep the wire in place.

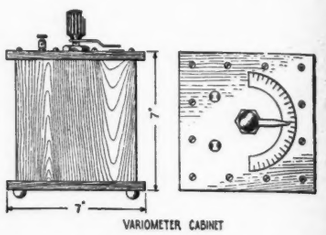


Fig. 3. The variometer may be mounted in a case, as shown, if portability is desired

The axis is a 5/32-in. brass rod threaded with an 8/32-in. die as shown in Fig. 3. If it is desired, the variometer can be used inside of a receiving cabinet and a pointer and handle fixed to the end of the axis. A 180-degree scale can be purchased to complete the instrument. In case it is not desired to use the variometer as a regular unit of the outfit, it may be mounted as an independent unit in a small cabinet as shown.

The method of securing the coils to the cover is shown in the drawing. The two small blocks are tacked to the larger coil in the center where there is no winding. The coils are then fastened to the cover by screwing the blocks to it. This method holds the coils very securely and makes a very rugged instrument.

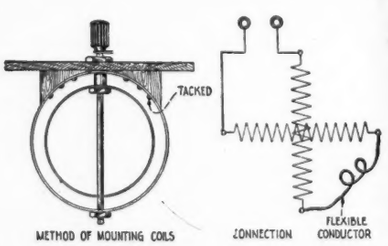


Fig. 4. How the coils are attached to the upper board. Right: diagram of primary to secondary intercoil connections

To interest and develop your boy-

AS he inclines in reading so your boy grows. Good reading habits started early assure healthy mental traits and develop ambition. The special articles, the stories, the departments in

THE AMERICAN BOY

"The Biggest, Brightest, Best Magazine for Boys in all the World"

are edited to give boys "reading with a future to it." Hundreds of thousands of American boys draw inspiration and delight from its pages every month. Give your boy this splendid start.

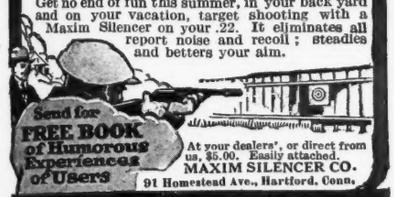
10c a copy on news-stands—$2.00 a year by mail.

THE SPRAGUE PUBLISHING CO.
28 American Building Detroit, Mich.

FUN!

Shoot Without Noise

Get no end of fun this summer, in your back yard and on your vacation, target shooting with a Maxim Silencer on your .22. It eliminates all report noise and recoil; steadies and betters your aim.



Send for FREE BOOK of Humorous Experiences of Users

At your dealers', or direct from us, $5.00. Easily attached.
MAXIM SILENCER CO.
91 Homestead Ave., Hartford, Conn.

MAXIM SILENCER

DEAFNESS IS MISERY

I know because I was Deaf and had **Head Noises** for over 30 years. My invisible Antiseptic Ear Drums restored my hearing and stopped Head Noises, and will do it for you. They are Tiny Megaphones. Cannot be seen when worn. Effective when Deafness is caused by Catarrh or by Perforated, Partially or Wholly Destroyed Natural Drums. Easy to put in, easy to take out. Are "Unseen Comforts." Inexpensive. Write for Booklet and **my sworn statement** of how I recovered my hearing.

A. O. LEONARD
Suite 301, 70 5th Avenue • • New York City

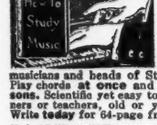
Improve Your Voice

Send now for information on the famous Feuchtinger Method. A course of easy, silent exercises for the vocal organs. Used at home. Makes weak, harsh and husky voices strong and clear. Special attention to stammering and lisping. Recommended by greatest singers and speakers of Europe. No matter how hopeless your case may seem, send for literature.

Write Today for our literature, absolutely FREE and postage prepaid. Send for it now.

Perfect Voice Institute, Studio C120 1772 Wilson Ave., Chicago

FREE BOOK



Learn Piano!

This Interesting Free Book

shows how you can become a skilled player of piano or organ in your own home, **at one quarter usual cost.** Dr. Quinn's famous Written Method is endorsed by leading musicians and heads of State Conservatories. Successful 26 years. Play chords **at once** and complete piece in every key, **within 4 lessons.** Scientific yet easy to understand. Fully illustrated. For beginners or teachers, old or young. **All music free.** Diploma granted. Write **today** for 64-page free book, "How to Study Music".

W. L. QUINN CONSERVATORY, Studio Z H, Social Union Bldg., Boston, Mass.

Books For Mechanics

Sheet Metal Work—A manual of practical self-instruction in the art of pattern drafting and construction work in light and heavy-gauge metal, including skylights and roofing, cornice work, etc. Cloth, 288 pages, 370 illustrations. *Price*, $2.00, *Postpaid.*

Machine Shop Work—A comprehensive guide to the most approved methods in modern shop practice, the construction and use of improved tools and machines, hand tools, the lathe and lathe tools, the methods of screw cutting, taper and eccentric turning, etc. Leather, 275 pages, 325 illustrations. *Price*, $1.75, *Postpaid.*

POPULAR SCIENCE MONTHLY
225 WEST 39th STREET
NEW YORK CITY

Now Radio Must Needs Argue with Fire Chiefs

IN the opionion of M. George A. Leroy, a chemist of Rouen, France, the ether waves of radiotelegraphy may be the direct cause of many large fires otherwise unexplainable. He finds by experiment that if one of the iron bands of a cotton-bale breaks, though remaining in the same general position as before on the bale, it is quite capable of acting as a loop receiver and resonator of the classical Hertz type for the picking up of radio waves. This may result in sparks passing between the broken ends of the iron band, setting fire to the jute wrappers of the bale, and thence the bale itself. Perhaps many of our "spontaneous" cotton-warehouse fires really originated in this manner. Scientists are investigating the problem further.

M. Leroy in his experiments arranged laboratory apparatus closely approximating conditions as they might exist in warehouses. Then, with an induction-coil generator of Hertzian waves of suitable size, he tested out results as they might actually occur. In his opinion, the metallic bands of closely adjacent cotton-bales might even pick up waves enough to result in sparks passing between them, let alone the kind that may result when the bands themselves are broken. Phenomena of this kind, however, are more likely to occur in the neighborhood of large commercial wireless stations than elsewhere, because of their powerful waves.

Radio Enthusiasts—Hear Ye!

THIS concludes our Radio Experiment Department for this issue. Do not miss the article on vacuum valves beginning on page 67. Next month we promise you several more columns of exceedingly interesting articles on the newest and best in radio. Experimenters, manufacturers, research men, and the industry in general all over the country are cooperating to make this the standard medium of the radio field.

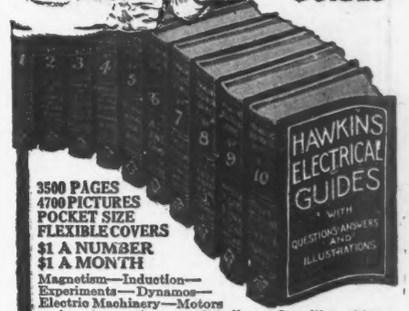
No magazine in America that takes up radio has the standing and circulation of POPULAR SCIENCE MONTHLY. No magazine is as independent, and as interested in giving impartial, adequate, and satisfying analysis of this marvelous field. If you are a worker in radio, an experimenter, a manufacturer, or just a general wholesale enthusiast, let us know what you think and are doing. The POPULAR SCIENCE MONTHLY wants the ideas of all. Readers in all parts of the world have always found in POPULAR SCIENCE MONTHLY a veritable mine of ideas and information. Especially is this becoming true of the magazine's interest in radio. Send us your ideas, your new developments, the discoveries you've made or know of someone else's making.

POPULAR SCIENCE MONTHLY pays liberally for all acceptable contributions.

Get Bigger Pay through ELECTRICITY

You will find in HAWKINS GUIDES just what you need to know about electricity. In simple everyday language—complete, concise, to the point. In questions and answers. A complete standard course in Electrical Engineering. Send for your set today to look over.

HAWKINS ELECTRICAL GUIDES



3500 PAGES
4700 PICTURES
POCKET SIZE
FLEXIBLE COVERS
$1 A NUMBER
$1 A MONTH

Magnetism—Induction—Experiments—Dynamos—Electric Machinery—Motors—Armatures—Armature Windings—Installing of Dynamos—Electrical Instrument Testing—Practical Management of Dynamos and Motors—Distribution Systems—Wiring—Wiring Diagrams—Sign Flashers—Storage Batteries—Principles of Alternating Currents and Alternators—Alternating Current Motors—Transformers—Converters—Rectifiers—Alternating Current Systems—Circuit Breakers—Measuring Instruments—Switch Boards—Power Stations—Installing—Telephone—Telegraph—Wireless—Bells—Lighting—Railways. Also many modern Practical Applications of Electricity and Ready Reference Index of the 10 numbers.

Shipped to you FREE. Not a cent to pay until you see the books. No obligation to buy unless you are satisfied. Send coupon now—today—and get this great help library and see if it is not worth $100 to you—you pay $1.00 a month for 10 months or return it.

SEND NO MONEY

THEO. AUDEL & CO., 72 Fifth Ave., N. Y. Please submit for examination Hawkins Electrical Guides (Price $1 each). Ship at once, prepaid, the 10 numbers. If satisfactory, I agree to send you $1 within seven days and to further mail you $1 each month until paid.

Signature_____
Occupation_____
Employed by_____
Residence_____
Reference_____ P.S.M.8.'19

DAYTON AIRLESS -TIRES-

Can't Puncture Can't Blow Out

Piers of live, elastic rubber built about one inch apart inside the casing and vulcanized or welded to it take the place of an inner tube. Nothing can happen but wear.

30x3 and 30x3½ sizes only—Ford Sizes. More than 50,000 cars equipped with them in 6 years.

Big Money in becoming our exclusive dealer in your county. Tire experience unnecessary. Write today for terms.

Dept. P. S. The Dayton Rubber Mfg. Co. Dayton, O.

Turn A Valve and Cook

The OLIVER OIL-GAS BURNER makes any stove or range a gas stove. No coal or wood. Cooks and bakes better. No fires to start. You regulate flame. Saves money, work, dirt. Burns coal-oil (kerosene). Simple, safe, easily put in or taken out. No damage to stove. Lasts a lifetime. Thousands of delighted users. In use seven years. Write us for FREE literature. AGENTS WANTED.
Oliver Oil-Gas Burner & Machine Co., 1833 N. 7th St., St. Louis, Mo.

Make Your Stove A Gas Stove

Telegraph Pictures
BY ELECTRICITY

Complete sets of two machines of this marvelous equipment at ridiculously low prices. Instructive, mystifying and useful. This picture of President Wilson was telegraphed by these machines. Will transmit pictures, maps, drawings and hand writing. Picture telegraphing is the coming science. Write today.

J. LEISHMAN CO., Dept. H. Ogden, Utah

Save TIRES LIKE THESE

I Earned $2200 In Four Months

This is Richard A. Oldham

Mr. Oldham was te. graph operator for the Illinois Central Railroad for twenty years. He is fifty-eight years old. One day he read one of my advertisements and the possibilities of making money in Auto Tire Surgery business. In a few weeks he had purchased and installed a Haywood outfit. A short time afterward he wrote us that his income in four months was as much as it had been in Two and One-Half years as Telegraph Operator.

Be a TIRE SURGEON

Make $2,500 to $4,000 Per Year Giving New Life to Old Tires

A Haywood Tire Surgeon can do more with old tires than was even dreamed before the war. By the **Haywood Method** a **Haywood Tire Surgeon** can give 4,000 to 5,000 more miles of new life to a tire that two years ago would have been thrown on the junk pile. And it's easy to learn.

HAYWOOD'S TIRE SURGERY

Stations are Needed Everywhere

20,000,000 tires wearing down every day. By Tire Surgery you can quickly repair, rebuild and give new life to tires seemingly all worn out. Cuts, gashes, tears, bruises, broken fabric, every kind of an accident that can happen to **any** tire, inside or out, you can repair and save for long service. **The chance to make money is simply wonderful.**

$2,500 to $4,000 a Year is Possible

If we told you all the truth you wouldn't believe it. You would say, "it is too good to be true." But you can see what a great field there is for **Haywood Tire Surgery Stations**—for this better way.

WITH THIS HAYWOOD OUTFIT

WRITE TODAY

Send Today for My Free Book

I have ready to mail you the day I get your request, a fascinating book—all about tires—how to repair them by the Haywood Method—how to start in business—how to build up trade—what to charge. In 48 to 72 hours you can have the whole proposition right in front of you. Use coupon at the left.

M. HAYWOOD, President
HAYWOOD TIRE & EQUIPMENT CO.
967 Capitol Ave. Indianapolis, Ind.

DEAR SIR: Please send me by return mail your free book on the new Haywood Tire Surgery Method and the details of your free school of tire repairing.

Name _____

Address _____

M. Haywood, Pres.
Haywood Tire & Equipment Co.
967 Capitol Ave.
Indianapolis
Indiana

Indoor Toilet
Convenient – Sanitary

The Comfort Closet for Homes, Summer Cottages and Camps. Entirely odorless. Scientifically ventilated. Strong chemicals dissolve contents; kills all germs. Easily installed. Convenient to move. Contents disposed of easily as garbage. Prevents fly breeding and water contamination. Provides sanitary, odorless toilet in home protected from cold and stormy weather. Only closet with porcelain container. Easily cleaned. Approved by U.S. Health Bureau. 30 Days' Free Trial. Agents make $60 to $100 weekly. Exclusive territory. Ask for booklet—FREE.
Comfort Chemical Closet Co., 1328 Factories Bldg., Toledo, O.

$90 to $250 a Month Free Book Tells How

Write today for this big, new Free Book on
SIGNAL ENGINEERING
Railroads need men for this important work. Big positions open throughout United States. Big Free Book tells all about it—tells how you can get the exact training you need. Write for it—Today—Now!
Dept. of Signaling, Room C120, 1810 Wilson Avenue, Chicago

Arithmetic of Electricity
A practical treatise on electrical calculations of all kinds reduced to a series of rules. $1.00 *Postpaid.*
Popular Science Monthly, 225 West 39th St., New York

Red Seal Dry Batteries Are Guaranteed

to give absolute satisfaction for Automobiles, Motor Boats, Gas or Gasoline Engine Ignition, Medical Batteries, Telephone, Door Bells, Annunciators, Wireless Apparatus or any other open circuit work.

ASK YOUR DEALER

Send for Our New Edition of Our Catalog A28

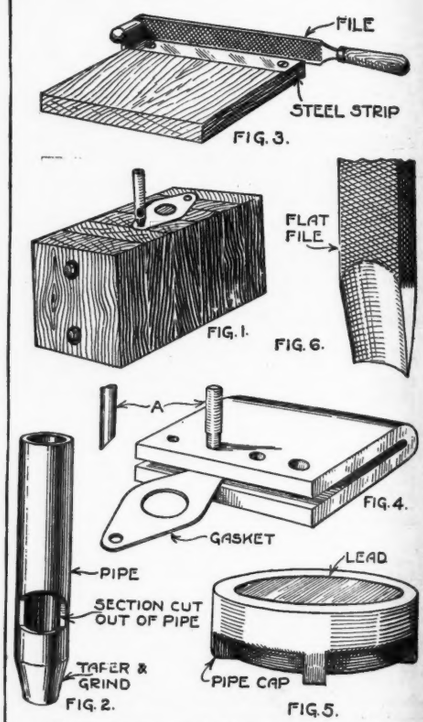
It will be pocket size, 8 x 4½ and will contain 248 pages with over 1,100 illustrations, describing in plain, clear language all about Bells, Push Buttons, Batteries, Telephone and Telegraph Material, Electric Toys, Burglar and Fire Alarm Contrivances, Electric Call Bells, Electric Alarm Clocks, Medical Batteries, Motor Boat Horns, Electrically Heated Apparatus, Battery Connectors, Switches, Battery Gauges, Wireless Telegraph Instruments, Ignition Supplies, etc.

MANHATTAN ELECTRICAL SUPPLY COMPANY, Inc.
NEW YORK, 17 Park Place CHICAGO, 114 So. Wells St. ST. LOUIS, 1106 Pine St. SAN FRANCISCO, 604 Mission St.

Things to Know About Gasket Tools

WHEN one has to make his own gaskets there is need of special tools, such as gasket punches and packing shears, to cut the material into shape and make the bolt holes. A few home-made tools, such as are shown in the sketches, will be found easy to make, and while they are small in cost they do the work very well. Almost anyone handy with tools can make them.

Fig. 1 illustrates a very durable and useful punch block, on which the



These simple gasketing tools make for efficiency in that "wheezing" engine

gasket material is laid and punched; it consists of several pieces of 2-in. plank, bolted together, sawed even at their ends, and used end up so that the punch sinks readily into the grain, thus making clean-cut holes and not dulling the edges of the punch. When the block becomes a little worn the surface is trimmed with a saw, thus giving new surface.

Fig. 2 shows how to make good gasket punches from short pieces of any size pipe. The end of the piece is ground taper to give the cutting edge, and a small section cut out of the side of the pipe with a hack saw, through which to clear the gasket washer or slugs.

Fig. 3 shows how a board for trimming packing may be made from a flat file and a piece of hard wood board, and a strip of flat steel stock. The file is made into a cutter by grinding one side and the lower edge smooth and free of file teeth and punching a hole through the end of it to attach it to the hinge bracket secured to the board.

One ingenious mechanic conceived the idea of making a punch plate for

cutting gasket bolt holes, as shown in Fig. 4. The plate is made from a piece of ⅜-in. steel, bent over double, with just space enough between for the packing. A series of standard size bolt holes, drilled through both parts of the plate, make a guide and die hole for the special punches (a size for each hole): the cutting ends of the punches are ground slightly bevel to make the cutting easier.

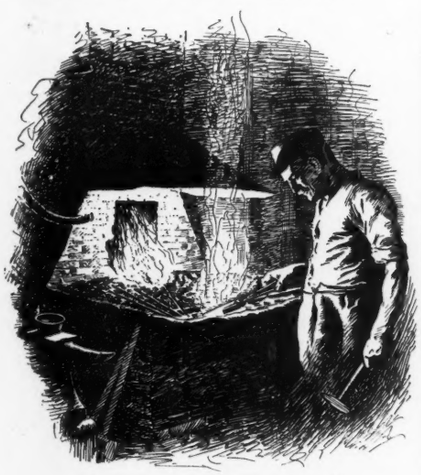
A very useful small size punch block, on which to cut packing material with punches or gouge chisels, can be made as shown in Fig. 5; a large size pipe cap is poured full of melted lead, which, when cool, is filed flush with the top.

Very satisfactory and durable gauge chisels for packing cutting can be made from sections of flat files, as shown in Fig 6.—C. H. WILLEY.

How to Temper and Take Care of Steel

TAKE 2 cups of water, ½ cup of wheat flour, and 1 cup of salt. Mix these into a paste and when a piece of steel which it is desired to harden is sufficiently hot to make the mixture stick to it, dip it into the mixture. Heat the steel to a cherry red and plunge at once into cold, soft water. If properly done the steel will emerge with a beautiful, smooth white surface, and will be very hard.

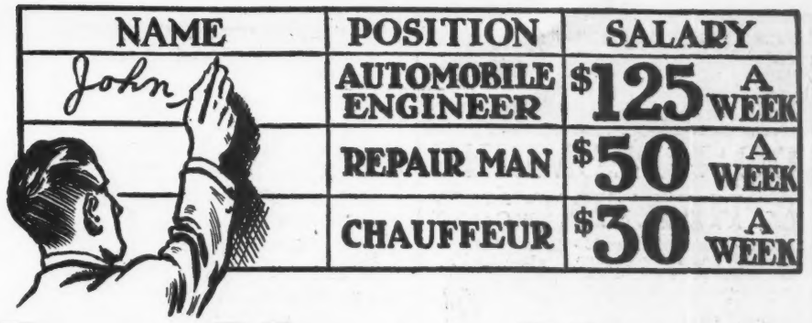
To remove rust from steel, cover the rusty parts with sweet oil or kerosene, and leave it on for about 38 hours. Then polish with finely powdered, unslaked lime and an oiled cloth.



It is easy to temper steel if you know how to go about it

To prevent steel from rusting use the following: Dissolve ½ oz. of powdered camphor gum in 1 lb. lard by heating and mixing them together. Remove any scum that rises to the surface, then stir in just enough powdered black lead to give it an iron color. Rub on this mixture, leaving it for about 24 hours. Then rub it off with a soft cloth.

Pure white lead and red lead, equal parts, mixed with boiled linseed oil to the desired consistency, will tightly cement both steam- and water-pipe joints.—C. HAMILTON.



Put Your Name On This Pay-Roll

Men like you are wanted for big-pay positions in the fascinating field of automobile engineering. We have made it easy for you to fit yourself for one of these positions. You don't have to go to school. You don't have to serve an apprenticeship. Fifteen automobile engineers and specialists have compiled a spare time reading course that will equip you to be an automobile expert without taking any time from your present work.

AUTO BOOKS

5 Volumes Shipped Free

Now ready for you—an up-to-the-minute five-volume library on Automobile Engineering, covering the construction, care and repair of pleasure cars, motor trucks and motorcycles. Brimming over with advanced information on Lighting Systems, Garage Design and Equipment, Welding and other repair methods. Contains everything that a mechanic or an engineer or a motorcyclist or the owner or prospective owner of a motor car ought to know. Written in simple language that anybody can understand. Tastefully bound in American Morocco, flexible covers, gold stamped, 2,400 pages and 2,000 illustrations, tables and explanatory diagrams. A library that cost thousands of dollars, to compile but that comes to you free for 7 days' examination.

Partial List of Contents

Explosion Motors
Welding
Motor Construction and Repair
Carburetors and Settings
Valves, Cooling
Lubrication
Fly-Wheels
Clutch
Transmission
Final Drive
Steering Frames
Tires
Vulcanizing
Ignition
Starting and Lighting Systems
Wiring Diagrams
Shop Kinks
Commercial Garage Design and Equipment
Electrics
Storage Batteries Care and Repair
Motorcycles
Commercial Trucks
Glossary

Only 7c a Day

Not a cent to pay in advance. First you see the books in your own home or shop. Just mail coupon and pay express charges when books arrive. You can read them and study them for seven whole days before you decide whether you want to keep them or not. If you like the books send only $2 in seven days and $2 a month until the special introductory price of $17.80 has been paid. (Regular price $25.00.) Along with the set goes a year's consulting membership in the American Technical Society. (Regular price $12.) This great bargain offer must soon be withdrawn.

Send No Money Now

Don't take our word for it. **See the books without cost.** There is so much profit in this offer for you, that we urge you to waste not a moment in sending for the books. **Put the coupon in the mails today. Send no money—only the coupon!**

FREE!
With every set is included—FREE—a Consulting Membership which gives you the privilege of submitting your perplexing problems to a corps of experts for an entire year. This Consulting Membership regularly sells for $12.00.

American Technical Society
Dept. A 20 C, Chicago, Ill.

American Technical Society, Dept. A 20 C, Chicago, Ill.

Please send me the 5-volume set, Automobile Engineering, for 7 days' examination, shipping charges collect. If I decide to buy, I will send $2 within 7 days and the balance at $2 a month until the $17.80 has been paid. Then you send me a receipt showing that the $25.00 set of books and the $12 Consulting Membership are mine and fully paid for. If I think I can get along without the books after the seven days' trial I will return them at your expense.

Name .....

Address..... Reference.....

½ SAVED
GET OUR
BIG BOOK

DO YOUR OWN PLUMBING & HEATING AT LOW COST

Send for our big instructive 256 page well-bound Handy-Man Book Catalog. Every Home Owner, Contractor, Electrician, Farmer, Factory Manager, etc., needs it. Shows over 10,000 Fixtures and Supplies in plumbing and heating at wholesale. Shows how to save skilled labor, hard work and unnecessary material by

Our New Cut-to-Fit Method

This wonderful book helps you select and install the proper Plumbing, Water Supply System, Hot Air, Water or Steam plant. Besides being our Wholesale Catalog it has many practical plans, diagrams, sketches, elevations, etc., showing how to do the work this newer, cut-to-fit way. Any handy man with a few tools can easily do his own installing with the aid of this

New Handy-Man Book

We have spared no effort and have gone to a great expense to compile this valuable book. With economy still a necessity, it would be unpatriotic to send this expensive book broadcast to non-interested parties. Therefore, we request a temporary deposit for each copy of 25c which we refund on first order, or we send our Bargain Bulletin FREE.

Address Today

Hardin-Lavin Company
40 years at
4526-36-E Cottage Grove Avenue
Chicago

$500,000.00 plants behind our guarantee

Big Profits in Vulcanizing

We manufacture the Anderson Vulcanizers and teach you the Famous Anderson Method of Vulcanizing in five to ten days in our State School nearest to you, and guarantee to make a first-class vulcanizer out of you or refund your money. Many of our graduates make over $3,000 a year.

Visit the city of our nearest school where you can see all other makes and hear their Method of doing the work; then visit our Anderson school and get our Method. Go prepared to take five to ten days course of the Anderson method and you will know why our graduates make good.

If you do not buy then our course costs you $25, and any time thereafter if you buy, or if you buy at the start, you will be paid $2 per day expense money, because we sell the work you do.

Anderson Steam Vulcanizer Co.
3 Williams Bldg., Indianapolis, Ind., U.S.A.
Please print your name. We receive many we cannot make out.

"DON'T SHOUT"

"I hear you. I can hear now as well as anybody. 'How?' With THE MORLEY PHONE. I've a pair in my ears now, but they are invisible. I would not know I had them in, myself, only that I hear all right."

"The Morley Phone for the DEAF is to the ears what glasses are to the eyes. Invisible, comfortable, weightless and harmless. Anyone can adjust it." Over one hundred thousand sold. Write for booklet and testimonials.
THE MORLEY CO., Dept. 797, Ferry Bldg., Phila.

Raise Belgian Hares

for us. Wonderful profits easily made at home. We furnish stock and pay you $7 a pair and express charges and buy all you raise. Also cavies and squabs.

Illustrated catalog and contract Free

UNITED FOOD & FUR ASSOCIATION
329 West 48th St. Desk 4 New York

LEARN TELEGRAPHY

at home in shortest possible time, Morse or Wireless. OMNIGRAPH AUTOMATIC TRANSMITTER, connected with Sounder or Buzzer, sends you messages at any speed, just as expert operator would. Adopted by U. S. Govt. 6 styles. Catalog free.

OMNIGRAPH MFG. CO.
39-H Cortlandt St., New York

The How and Why of House Drawers

By Charles King

Valuable advice to those who contemplate house-building

IN every modern dwelling of the better class, drawer cases are generally built in, usually being made to fit odd spaces that can be put to no other use.

Drawers in the kitchen and pantry should be large enough to hold pans and covers of kettles, dish-towels, etc. Certain kitchen drawers should be made extraordinarily strong for the storing of flat-irons and the miscellaneous junk that usually collects about the kitchen. Other drawers should be made smaller, for holding spices and other light articles so dear to the heart of a housewife. And don't forget the drawer near the floor for shoes and rubbers. This will continually call down blessings upon your head.

In the dining-room there should be one drawer large enough to hold comfortably the largest table-cloth twice folded lengthwise, say not less than 3 ft. 6 in. long and 20 in. deep from the front to the back. A drawer of more than 8 in. high proves unsatisfactory. Other drawers in which may be kept small table linen and cutlery may be included in a sideboard or buffet.

If a case of drawers is located upon the second floor for chamber linen, some of them should be large enough to take a folded sheet or spread, say about 2 ft. 6 in. by 16 in. deep, and the drawers for unused clothing should be about the same size.

The man who builds a house to sell will find that nothing makes so strong an appeal to the housewife as an abundance of drawer space, unless it be liberal closet convenience. Nothing will ruin a naturally fine feminine disposition more quickly than drawers that do not slide out and back as they should.

How to Put in the Drawer

The usual method of making drawers in a new building is to fit the front, sides, and back as shown in Fig. 1, gluing and nailing them together. A drawer bottom, made of one or two wide boards, will be sufficient in most cases, as the bottom will prevent the drawer from racking diagonally, while narrow unglued pieces will slide by each other and add but little to the strength of the drawer.

If the drawer is factory-made the front and back will often be milled, glued, and nailed as shown in Fig. 2, or fastened by some form of machine dovetailing. To do the best work dovetail the drawer as indicated in Fig. 3. The width of the back should be ⅛ or ¼ in. less than the distance between the top edge of the bottom groove and the top of the side as shown in Fig. 4, and be fastened so that its lower edge will just come to the top of the groove, as in *a*, leaving a space at the top, *b*, to allow for planing down the side to fit the height of the opening, and to prevent the top of the back from catching under the partition above when the drawer is pulled out. The usual method of placing a drawer is shown in Fig. 4, a groove in the lower back edge of the front corresponding to the groove in the side.

If a dovetailed drawer is made, the half tail at *a*, in Fig. 3, should be so placed that it will cover the bottom groove in the back side of the drawer front, or otherwise it will show on the side of the drawer. The top edge of the front should pass by the end of the side, as at *d* in Fig. 3, and by the side of the back as at *e*.

Reducing Wear to a Minimum

Most factory-made drawers have ½ insides and bottom, but the sides of a drawer more than 30 in. long should be ⅝ in. thick. The back of a well

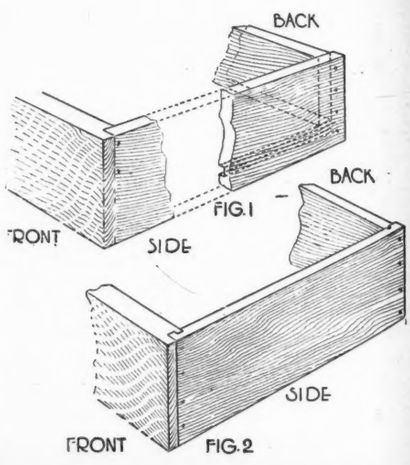


Fig. 1, Nailing and gluing the boards together. Fig. 2, Machine dovetailing which is afterwards glued and nailed

The most impressive of the profound writings of **Emanuel Swedenborg** the renowned theologian, philosopher, and scientist.

Heaven and its Wonders and Hell

This 632-page book, well printed, substantially bound, treating of the life after death, sent without further cost or obligation on receipt of 5 cents.

Write for complete list of publications

The American Swedenborg Printing and Publishing Society
Room 778, 3 W. 29th St., N. Y.

DIAMONDS ON CREDIT
WATCHES

Loftis Solitaire Diamond Cluster Ring

Has the exact appearance of a large handsome Solitaire Diamond that would cost three or four times as much.

Send for Free Catalog

There are over 2000 illustrations of Diamonds, Watches, Jewelry, etc. Whatever you select will be sent, all shipping charges prepaid.

You See and Examine the Article Right in Your Own Hands

If satisfied pay one-fifth of purchase price and keep it; eight equal amounts payable monthly.

Our Catalog shows all the new Watches. Big bargains in **25-year guaranteed Watches on credit terms as low as**

$2.50 a Month

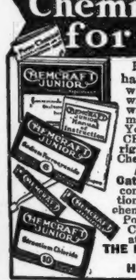
LIBERTY BONDS ACCEPTED

Looks Like What it is Intended For—a Large Single Diamond
Splendid Bargains Now Offered at $85, $125, $150 and $200.
EASY CREDIT TERMS

The secret of the rare beauty of the Loftis 7-Diamond Cluster Ring lies in the perfectly matched stones, all the diamonds being uniform in size, quality and brilliancy; mounting is 14 karat solid gold. Very popular.

LOFTIS BROS & CO. Since 1858
The National Credit Jewelers
Dept. C-871 108 N. State Street
CHICAGO, ILL.
STORES IN LEADING CITIES

Chemical Tricks for Boys



Puzzle your friends with mysterious, harmless Chemical tricks. Pour red, white and blue from a glass of water; write secret letters with invisible ink; write with water and have it turn blue; make your own blue ink or ink powder. You can do these tricks with "CHEMCRAFT" Junior. Send for your outfit right away and get a Free copy of "The Chemcraft Chemist."

Amateur Chemist's Catalogue and Hand Book contains valuable information for Boys; lists useful chemicals and apparatus. 10c Postpaid. Regular "CHEMCRAFT" Chemical Outfits, at $1.50, $3.00 and $5.00.

THE PORTER CHEMICAL CO.
Industrial Arcade
Hagerstown, Md.

CHEMCRAFT JUNIOR
25¢
POSTPAID

CLEARTONE PHONOGRAPHS
$4.00 to $200.00 Retail

Our Sundry Dept. offers Needles 39c. per thousand, in lots of 500,000. Motors $1.35 to $14.75 each. Tone Arms and Reproducers $1.30 to $5.75 per set. Main Springs 20c. to 90c. each. Records, Needles, Sapphire Points and Parts at reasonable prices.

Write for our 84 page catalogue, the only one of its kind in America, illustrating 33 different styles of Talking Machines and over 500 different Phonographic Parts.

LUCKY 13 PHONOGRAPH COMPANY
Export Dept. 46G, E. 12th St., N.Y., U.S.A.

proportioned drawer may be 1-1/16 in. shorter than the front. A piece under the bottom of the drawer at *c*, Fig. 4, will increase the bearing of the drawer sides so that the wearing will be reduced to a minimum, and the drawer will run smoothly and easily. This method should be practised upon large drawers or on drawers that hold heavy articles. The grain of the drawer bottom should be parallel with the front, not with the sides. The front of the bottom should be glued into the front groove, so that the shrinking and swelling will all come on the back edge, for if the grain ran the other way the bottom might shrink out of the groove, or swell so that it would push the sides out of line, preventing the drawer from either opening or closing.

One of the old-fashioned ways of making a drawer bottom, which is still

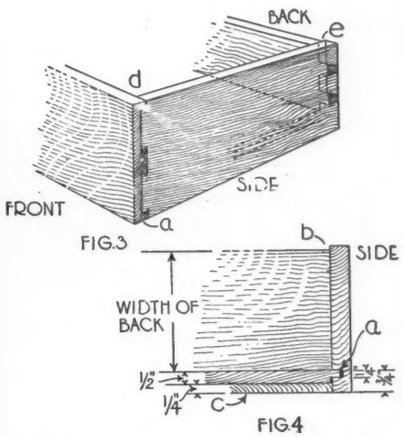


Fig. 3. The top edge of the front should pass by the end of the side. Fig. 4. A groove in the lower back edge of the front corresponds to a groove in the side

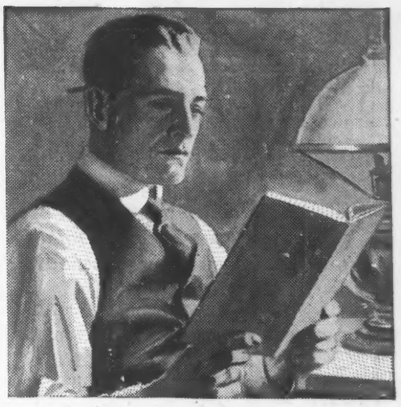
occasionally used upon the best class of work, is to make a flush panel bottom and glue it upon the edges of the sides and back, then rabbet it into the front. Sometimes a sunken panel is used instead of a flush panel, with a rail or panel frame around it.

In selecting the stock for a drawer, it is imperative that it should be straight grained or there will be trouble in making the drawer run smoothly (this is especially important regarding the front). If a drawer is to be dovetailed the front should be fitted closely into the space it is to fill and the dovetailing done afterward.

Things to Avoid

A drawer may be fitted either too closely or too loosely, but proportions are a large factor in the smoothness of its running qualities. Generally speaking, if a drawer is less than one third as deep as it is long, or if its height and depth are about equal, it is probable that there will be trouble with the drawer in time.

To insure a smoothly running drawer there should be a bearing above to prevent the front from dropping when it is more than half way out. In fitting a



$95 an Hour!

"Every hour I spent on my I. C. S. Course has been worth $95 to me! My position, my $5,000 a year income, my home, my family's happiness—I owe it all to my spare time training with the International Correspondence Schools!"

Every mail brings letters from some of the two million I. C. S. students telling of promotions or increases in salary as the rewards of spare time study.

What are you doing with the hours after supper? Can you afford to let them slip by unimproved when you can easily make them mean so much? One hour a day spent with the I. C. S. will prepare you for the position you want in the work you like best.

Yes, it will! Two million have proved it. For 28 years men in offices, stores, shops, factories, mines, railroads—in every line of technical and commercial work—have been winning promotion and increased salaries through the I. C. S. More than 100,000 men and women are getting ready *right now* with the I. C. S. help for the bigger jobs ahead.

Your Chance is Here!

No matter were you live, the I. C. S. will come to you. No matter what your handicaps, or how small your means, we have a plan to meet your circumstances. No matter how limited your previous education, the simply written, wonderfully illustrated I. C. S. textbooks make it easy to learn. No matter what career you may choose, some one of the 280 I. C. S. Courses will surely suit your needs.

When everything has been made easy for you—when one hour a day spent with the I. C. S. in the quiet of your own home will bring you a bigger income, more comforts, more pleasures, all that success means—can you let another single priceless hour of spare time go to waste? Make your start right now! This is all we ask: Without cost, without obligating yourself in any way, put it up to us to prove how we can help you. Just mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 7648, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

☐ ELECTRICAL ENGINEER	☐ SALESMANSHIP
☐ Electric Lighting and Rys.	☐ ADVERTISING
☐ Electric Wiring	☐ Window Trimmer
☐ Telegraph Engineer	☐ Show Card Writer
☐ Telephone Work	☐ Sign Painter
☐ MECHANICAL ENGINEER	☐ Railroad Trainman
☐ Mechanical Draftsman	☐ ILLUSTRATING
☐ Machine Shop Practice	☐ Cartooning
☐ Toolmaker	☐ BOOKKEEPER
☐ Gas Engine Operating	☐ Stenographer and Typist
☐ CIVIL ENGINEER	☐ Cert. Pub. Accountant
☐ Surveying and Mapping	☐ TRAFFIC MANAGER
☐ MINE FOREMAN or ENG'R	☐ Railway Accountant
☐ STATIONARY ENGINEER	☐ Commercial Law
☐ Marine Engineer	☐ GOOD ENGLISH
☐ Ship Draftsman	☐ Teacher
☐ ARCHITECT	☐ Common School Subjects
☐ Contractor and Builder	☐ Mathematics
☐ Architectural Draftsman	☐ CIVIL SERVICE
☐ Concrete Builder	☐ Railway Mail Clerk
☐ Structural Engineer	☐ AUTOMOBILE OPERATING
☐ PLUMBING AND HEATING	☐ Auto Repairing
☐ Sheet Metal Worker	☐ Navigation
☐ Textile Overseer or Supt.	☐ AGRICULTURE
☐ CHEMIST	☐ Poultry Raising
	☐ Spanish ☐ French ☐ Italian

Name_____
Present Occupation_____
Street and No._____
City_____ State_____

Canadians may send this coupon to International Correspondence Schools, Montreal, Canada

PATENTS TRADE-MARKS AND COPYRIGHTS

Before disclosing an invention, the inventor should write for our blank form "EVIDENCE OF CONCEPTION." This should be signed and witnessed and if returned to us together with model or sketch and description of the invention, we will give our opinion as to its patentable nature.

Our Illustrated Guide Book, HOW TO OBTAIN A PATENT, sent Free on request. Contains full instructions regarding Patents, Trade-Marks, Foreign Patents, Our Methods, Terms, and 100 Mechanical Movements illustrated and described, Articles on Patent Practice and Procedure, and Law Points for Inventors.

Highest References *Prompt Service* *Reasonable Terms*

FREE COUPON!

VICTOR J. EVANS & CO., Patent Attorneys

New York Offices 1001 Woolworth Bldg. *Philadelphia Offices* 135 S. Broad Street *Pittsburgh Offices* 514 Empire Bldg.

Main Offices: 760 9th Street, N. W., WASHINGTON, D. C.

GENTLEMEN: Please send me FREE OF CHARGE your Book as described above.

NAME.....ADDRESS.....

PATENTS and Trade Marks

Send sketch or model for actual search and report. Write for Booklet of instructions on patent practice and procedure. Prompt personal service....

Geo. P. Kimmel
Patent Lawyer
39-W Loan and Trust Building, Washington, D. C.

PATENTS
LACEY & LACEY
Attorneys-at-Law — Patent Practice Exclusively
Solicitors of
U. S. and Foreign Patents
Trade-Marks, Copyrights.
645 F Street, N.W., Washington, D. C.
Write Us for Our Free Inventors' Book
PATENT-SENSE
ESTABLISHED 1869

PATENTS PROCURED and TRADE-MARKS REGISTERED
Eighteen Years' Experience. Instructions and Terms on request.
ROBB & ROBB, Attorneys at Law
Specializing in Patent and Trade-mark Practice exclusively
840 Southern Bldg., Washington, D. C. 1336 Schofield Bldg., Cleveland, Ohio.

PATENTS AND TRADE MARKS
LANCASTER & ALLWINE
274 OURAY BLDG. WASHINGTON, D.C.
DO NOT LOSE YOUR RIGHTS TO PATENT PROTECTION
Before disclosing your invention to any one send for blank form **"Evidence of Conception"** to be signed and witnessed. Establish your rights before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the U. S. and Canada in the advancement of their inventions. Terms reasonable. The form **"Evidence of Conception,"** sample, instructions relating to obtaining of patent and fee schedule sent upon request. Ask for them,—a postcard will do.

Arithmetic of Electricity—A practical treatise on electrical calculations of all kinds reduced to a series of rules. *$1.00 Postpaid.* Popular Science Monthly, 225 West 39th St., New York.

PATENTS IF YOU HAVE AN INVENTION AND DESIRE TO LEARN HOW TO SECURE A PATENT, send for Our Guide Book, **HOW TO GET A PATENT,** sent Free on request. Tells our Terms, Methods, etc. Send model or sketch and description of your invention and we will give our opinion as to its patentable nature.

RANDOLPH & CO.
130 F St., N. W., Washington, D. C.

NAME.....
STREET.....
CITY.....STATE.....

drawer, the bottom of the sides must be joined straight and flush with the bottom of the front, which should be planed to fit the partition, and its lower inside edge planed under so that it will not catch.

Plane the top edge of each side so that the drawer will slide into its opening easily, fitting only one side at a time, thus doing the work accurately. Plane the drawer a close fit by taking no more off the sides than is necessary to allow the drawer to run smoothly. If a wax candle is rubbed upon the sides of the opening and upon the edges of the sides to reduce friction, the drawer may be fitted more easily. If the work is done in damp weather the drawer should be run as closely as possible, because the sides will shrink when exposed to artificial heat. If it is winter the drawer should be fitted loosely, because in the damper air of summer the wood will swell and make the drawer bind.

There are times when it is necessary to nail the drawer guides in before the drawer is fitted, but both time and efficiency will be served if they can be left off until the fitting of the drawer is completed. In such cases, however, the drawer may be run in until its front is as nearly flush with the face of the case as it is possible to make it, after which the guides are nailed closely together against the drawer sides. Another way is to make a pencil line upon the partition close against each side, then remove the drawer and nail the guides accurately to these marks. Replace the drawer, and with a sharp knife mark around the drawer front to designate the amount of wood to be planed off to make the drawer flush.

When to Use a Center Run

A shallow drawer, or one of awkward shape, may have a center run, as indicated in Fig. 6. Guides must be slightly thinner than the distance between the drawer bottom and the partition that supports the drawer. These guides may be fastened squarely upon the edge of the partition and far enough back to allow for the thickness of the drawer front. They must be parallel with each other and just far enough apart to allow easy running without looseness. Accurate work will do more to make the drawer run more smoothly than anything else.

If it is made of well dried stock, the clearance of a drawer need not be more than the thickness of a silver quarter.

An Emergency Repair for Commutators

WHEN an electrician is called upon to remove a "bug" from a commutator, it is the usual practice to fill the hole caused by digging out the mica with a paste of powdered mica and water-glass. When this is not handy a permanent job can be made by using plaster of paris and water to fill the holes.—THOMAS W. BENSON.

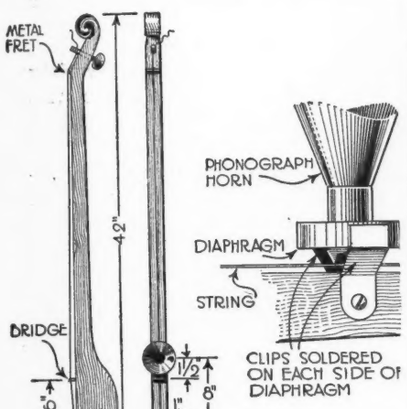
Be a Music Master and Make Your Own Instrument

A CLEVER little novelty is this musical instrument, which can be built with little or no mechanical ability.

A piece of maple or other hard wood is taken from a piece of flooring, cut 42 ins. in length, and shaped as shown in the illustration. The neck may be carved the same as that of a violin or left plain, depending upon one's ability in handling tools. This, however, has nothing to do with the tone of the instrument.

The base is cut off square and a piece of the same material 3 ins. wide and 8 ins. long attached to it with a round-headed screw, but left loose enough to allow free movement. A hole is next drilled in the neck and an old violin peg inserted, to which the string is later fastened.

A diaphragm from an old style phonograph—the kind with a horn—is next procured, two metal clips are soldered to it and holes punched into their opposite ends for attaching it



With a little practice, real music can be extracted from this little instrument

to the neck of the instrument. The instrument is now ready for assembling. One inch from the bottom a small screw is inserted into the front of the neck. At the opposite end a slot is cut and a small piece of steel inserted to form the fret. An "A" string is next wound about the small screw, taken up over the fret and through a hole in the violin peg, with which it is tuned.

A wooden violin bridge is then cut down to the width of the neck and placed beneath the string 6 ins. from the screw at the base. Now the diaphragm is set into place so that the arm rests directly upon the string and at a distance of 1½ ins. from the bridge. The sides are then screwed into place, the small horn inserted, and the instrument is ready for tuning. This is accomplished by tightening the string with the violin peg. The playing is done with a violin bow, the base of the instrument being held in position upon the knees.—HARRY MARCELLE.

PATENTS

Write for free booklet

Terms Reasonable — Highest References — Best Results

Send model or drawing for preliminary examination and report as to patentability

ALL BUSINESS GIVEN PROMPT AND PROPER ATTENTION

WATSON E. COLEMAN, Patent Lawyer, 624 F St., Washington, D.C.

PATENTS

INVENTORS

Before applying for a patent you should send us a sketch or model of your invention, with a description of it, and receive our "Evidence of Conception" form—our Opinion as to the Patentable Nature of your Invention, and our advice regarding the best way of obtaining patent protection. Our practical experience covers a period of twenty years. Our Handbook on Patents

HOW to OBTAIN a PATENT
SENT FREE

is a storehouse of valuable information and advice to inventors. All communications strictly confidential. Write us TODAY.

TALBERT & TALBERT
Patent Lawyers

4520 Talbert Bldg., WASHINGTON, D. C.

CAN YOU

think of a simple, practical idea that will fill one of the many requests we have on file for new inventions? It may mean a fortune for you. Thousands of things are needed RIGHT NOW. YOUR brains can help. Send today for our great new book—"Inventions and Trade Marks, Their Protection and Exploitation" and learn more about making money from ideas than you ever knew before. It tells many things that are wanted, too. A postal will do—it is free.

We help our clients, without charge, to get the dollars out of their ideas—having facilities none others possess.

Advice free.

Don't delay—get the book at once.

AMERICAN INDUSTRIES, INC.

201 Patent Dept., WASHINGTON, D. C.

PATENTS ADVERTISED For SALE FREE

In INVENTION And MANUFACTURING SUPPLEMENT.

Published for the man with an idea. Send for free sample copy. One year's subscription 50c.

Protect Your Rights to Invention

Write today for "Record of Invention" which contains forms to establish evidence of conception. Prompt personal service. Preliminary advice without charge.

J. REANEY KELLY
732-O Woodward Building, Washington, D.C.

Important Books on Wireless

Recommended by the Editor of Popular Science Monthly.

Elementary Principles of Wireless Telegraphy. By R. D. Bangay. Vols. I and II . . . Price, each, *post paid*, $1.25

Experimental Wireless Stations. By P. E. Edelman. 1914 Edition. Price, *post paid*, $1.00

Simple Wireless Telephones and How to Make Them . . . Price, *post paid*, $ .25

The Book of Wireless. By A. Frederick Collins. . . . . Price, *post paid*, $1.25

Text Book on Wireless Telegraphy. By Rupert Stanley . . Price, *post paid*, $2.50

Elementary Manual of Radio Telegraphy. By J. A. Fleming. Price, *post paid* $3.20

Handbook of Wireless Telegraphy. By J. Erskine Murray . Price, *post paid*, $4.50

Wireless Telegraphy. By J. Zenneck. Translated by A. E. Seelig. Price, *post paid*. $4.20

How to Conduct a Radio Club. By E. E. Bucher. . . .Price, *post paid*, $ .50

Every wireless amateur needs one or more of these books—address

POPULAR SCIENCE MONTHLY
225 West 39th Street, New York

PATENTS

To the Man With an Idea

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts, frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN
Patent Lawyer
6 Owen Building, Washington, D.C.
2276-D Woolworth Building, New York City

Making Your Invention a Financial Success

How best to dispose of your invention
What kind of agreements to make for your protection
What kind of offers and mistakes to avoid
Valuable tables and other data

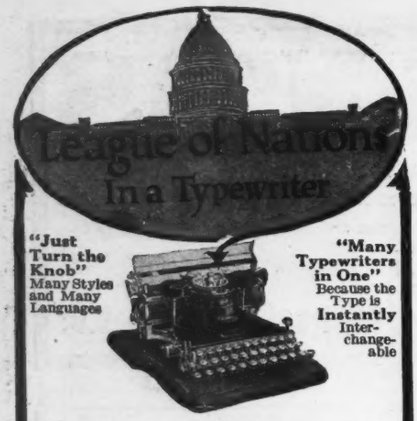
By M. G. Delaney, an experienced inventor, in

The Inventors' Manual of Valuable Information

$1.50 per copy, postpaid

Additional information and Table of Contents will be mailed on request.

G. E. Perry Company, Publishers, 1328 Broadway, New York



"Just Turn the Knob" Many Styles and Many Languages

"Many Typewriters in One" Because the Type is Instantly Interchangeable

Types for all purposes
and for all languages
Spacing to suit size of type
Perfect alignment
Automatic Type Impression
All on one MULTIPLEX

However many Nations are eventually recognized, and taken into a League, there is a typewriter that can write the language of each and every one, the—

MULTIPLEX HAMMOND

Standard "Writing Machine"

—the typewriter upon which the first covenants for a League of Nations were drawn up—the typewriter that the Press of the Nation refers to as "President Wilson's Closest Confidant."

The Multiplex is *un*-like any other typewriter—there are **over 365 different type-sets**, including all languages to select from. **Note the six styles shown above.**

This wonder-machine needs no interpreter—it can write each and every Nation's own language, its covenants and correspondence. Yet, with all its precision of mechanism, its instant change of languages and type-styles, it is most simple of operation, and does perfect work *automatically.*

Making Your Writing Talk!

With the Multiplex *you can put emphasis when and where you want it—literally making your writing talk.* That's why lecturers, lawyers, clergymen, authors, and business men who realize the value of *personality in writing*, use the Multiplex. In fact, this versatile machine often makes a man's writing more forceful than his speech.

Send for FREE PAMPHLET

"How President Wilson Frightened the Lords at Midnight," and other descriptive literature explaining the unique features of the Multiplex. Write your name, address and occupation on the margin of this page NOW and mail the margin to—

THE HAMMOND TYPEWRITER CO.
639 East 69th Street New York City

Also—an Aluminum PORTABLE Model
For Traveling—for Home. Weighs about 11 lbs. Full capacity.
Ask for special folder.

BOOKS ON FLYING

Building and Flying an Aeroplane—A practical handbook covering the design, construction and operation of aeroplanes and gliders. Cloth 150 pages. 50 illustrations. **Price, $1.00 postpaid.**

Harper's Aircraft Book—Why aeroplanes fly, how to make models, and all about aircraft little and big. It explains in a simple, lucid manner the principles and mechanism involved in human flight, and tells how to design and construct model aeroplanes, gliders, and man-carrying machines. 245 pages. Illustrated. **Price $1.10 Postpaid.**

POPULAR SCIENCE MONTHLY
225 West 39th Street, New York, N. Y.

Pictures on Cloth and How to Make Them

By Cora Hamilton

EVERYONE has seen pictures on cloth pillow tops, but few know that they can be cheaply and easily made at home. However, they can be, and here is the method.

Obtain some blue-print powder from any photographic supply house and dissolve a small amount in the required quantity of water, as set forth in the directions that accompany the package.

Smooth the cloth to be used on a piece of board with tacks, or pin or sew it to a sheet of cardboard; either way is satisfactory. Dip a brush in the solution and coat the cloth evenly with it, using long, clean strokes. Place it near a stove so that it will dry quickly, but keep it away from a bright light, either natural or artificial. Now take the negative or film to be used and insert enough of the cloth in the printing frame to accommodate the picture being printed. After exposure dip the cloth in cold water and while still damp press with a hot iron.

You have seen these picture pillow covers, but do you know that you could make them at home?

Silk, satin, linen or cotton may be used. The best result is obtained from a pink color, as pink and blue go well together. One or more pictures may be printed on the same piece of cloth, but they must all be exposed before development takes place. A variety of pretty gifts may be made this way.—CORA HAMILTON.

A Popular Disappearance Trick Explained

WITH the aid of a few sewing-machine stitches a trick may be devised that will equal, if not surpass, a well known magic effect often seen on the professional stage. The advantage of this trick is that no sleight-of-hand is necessary.

Two handkerchiefs (silk is easier to handle, but any fabric will answer) are tied together at their extreme corners and placed in an empty goblet or tumbler. A third handkerchief of a different color (or perhaps a flag would be better) is caused to disappear, removing the two handkerchiefs from the goblet the flag is found to be tied between them.

Presto! the performer produces three handkerchiefs where there were only two

Use fairly large handkerchiefs, folding one into a triangle, leaving an open space of an inch at the top of the right side of the triangle, and stitching the rest with thread. This forms a pocket that is closed at the top but open at the bottom. The handkerchief is hidden in this pocket, one end being sewed to the end of the handkerchief it is hidden in, while the other end is loose.

When the performer apparently fastens the handkerchiefs together, the third handkerchief is really tied to the loose ends of the hidden handkerchief. Of course, when the handkerchiefs are pulled apart they will be seen to all be tied together.

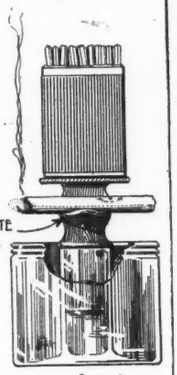
The vanishing of the handkerchief can be accomplished by an attached elastic, or this part may be entirely left out.—MERRITT HALE.

An Inexpensive Cement for Many Uses

THE body of the cement is litharge (lead oxide) and may be purchased at a drug store for about ten cents an ounce. Mix it with glycerine to the consistency of a very thick paste, and you have an excellent cement for resetting new lava flame-tips in bicycle and motorcycle acetylene gas head-lights. It will also fill, and make leak-proof, large holes in granite and aluminum kitchen-ware, and will repair a galvanized wash-tub or the copper wash-boiler, etc. It must be allowed to set for at least twenty-four hours. A mixture of litharge and shellac, having about the consistency of paste, makes a fine smooth-on cement for leaky automobile radiators and for cracks in the engine water-jacket. The mixture will dry sufficiently for refilling with water in about ten hours.—JOHN ROBINSON.

Transforming the Paste-Pot into a Smoking Set

AMONG the many novel and useful articles into which an empty paste-pot may easily be converted is the smoking set illustrated, which was made for an office desk. This device is very handy and occupies but little space.



The paste-pot makes a fine smoking set, and it's easy to make

The safety match-box holder is made in one piece, carved from a block of white pine, the lower end fitting tightly (like a cork) in the central cavity where the paste brush usually rests. The space around this container is used as an ash tray. On either side of the match-box holder post is a cigar holder made from a short length of wire.—F. H. LINTHICUM.

One Way to Make Perfect Smoke Rings

TAKE a small pasteboard box, seal the cover tight, and draw a funny face upon its cover. Cut an opening for the mouth and fill the box with smoke. Then, with quick, light taps, strike the bottom of the box and a series of perfect smoke rings will issue from the hole. A hundred or more rings can be thrown out of the box with only one filling of smoke.

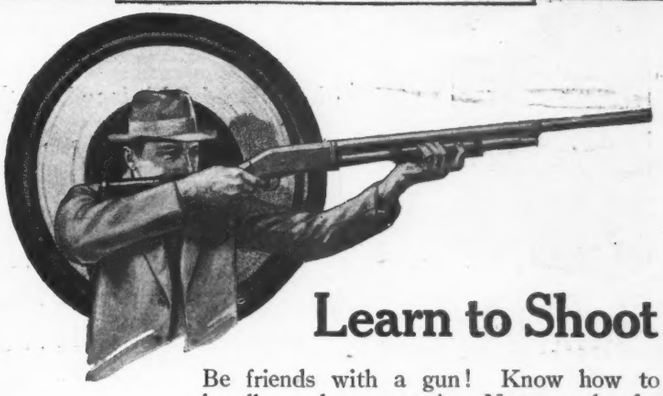
This is an easy way to study the seeming mystery of smoke rings. As

Fill the box with smoke, tap it, and perfect smoke rings issue from the hole

the smoke is forced out, it strikes the still air outside, and immediately breaks in the middle, forming a "doughnut" ring, which turns very rapidly on an axis lying in the center of the rim of smoke.

Much amusement may be obtained by two people, using a box each, holding the boxes vertically and trying to hit each other's rings in midair.—DALE R. VAN HORN.

DU PONT AMERICAN INDUSTRIES



Learn to Shoot

Be friends with a gun! Know how to handle and use one! Not merely for protection but for the good health it will bring you. An hour or two every week at

Trapshooting

will help take worries from your mind and kinks out of your muscles. Oxygen and recreative exercise, mental and muscular, is the best tonic in the world for men and women. Your local gun club is the place to get both.

Write for name of nearest club and our book "The Sport Alluring."

DU PONT

Smokeless Shotgun Powders

leaders for over a century, are the first choice of the Nation's crack shots.

Look on the shell box for the names

Dupont - Ballistite
Schultze

Sporting Powder Division
E. I. DU PONT DE NEMOURS & CO.
Wilmington, Delaware

Visit Du Pont Trapshooting School, Atlantic City, N. J.

DU PONT

20,000 Miles Without a Puncture

10 Day Free Trial

That's the remarkable record of Brictson Pneumatic Tires. Thousands of car owners know they are absolutely proof against punctures, blowouts, ruts, rim cuts, skidding, oil, gasoline. Furthermore they are Guaranteed for 10,000 Miles Service. Can you equal this for tire efficiency and economy?

TRY 'EM AT OUR EXPENSE

Make us prove it. Don't pay if not satisfied. Write to-day for details of most liberal, convincing "Free Trial" plan ever offered. Sent with illustrated, descriptive book

The Brictson Mfg. Co. Dept. 134-09
W. O. W. Bldg., Omaha, Nebr.

DOUBLE YOUR INCOME by RENEWING OLD TIRES

IT'S the biggest money maker today. Demand for repaired tires grows constantly. There never was a better time to start in this business. We teach you how to do expert work and show you best way to operate business. Repairmen make $30 to $50 a week; good repair shops make $100 to $300 a week.

WE TRAIN YOU BY MAIL

Our course goes right to your home. It is Complete, Inexpensive and Practical. We guarantee to train you to be an expert tire repairman in three months so that you can repair fabric tires, all makes of cord tires, big pneumatic truck tires and tubes. Course has endorsement of large tire factories. We show you how and where to get best equipment for doing work. Write today for free information and outline of our course.

HOVEY EXTENSION SCHOOL OF TIRE REPAIRING
312 SECOND NATIONAL BUILDING, AKRON, OHIO

WORK FOR YOURSELF

All right—You can start right away without giving up your present job. Take part of your spare time. Become local representative for Popular Science Monthly. There is great demand for this magazine on account of its war articles and pictures. It is easy, interesting and valuable work, with fine pay and business is your own.

POPULAR SCIENCE MONTHLY
225 West 39th Street, New York

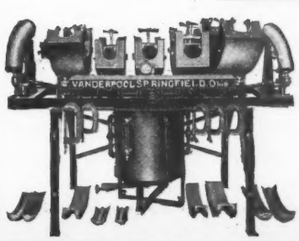
HERE BOYS

All the Parts & Plans
50 Cents Prepaid
—DON'T SEND STAMPS—

Put together in a JIFFY, flies 100 feet. Next contest Model Aero-Fleet, next Sept.

NIFTY NOVELTY & TOY CO.
NEWARK, N. J.

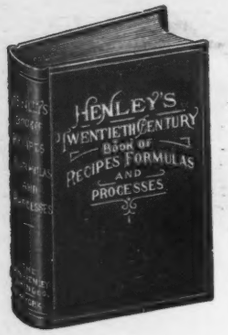
SUCCESS! MONEY!
IMMEDIATELY!!!



OPEN a Tire Repairing Shop—business pours in. Vanderpool Vulcanizer (5 Cavity) has capacity of $100 worth of work a day. We are the pioneer manufacturers of the Dry Cure Vulcanizer—the only vulcanizer that guarantees absolutely PERFECT work. This field is not crowded like others. Write at once for *FREE TIRE REPAIRING MANUAL*. Tells you everything necessary to know. Don't delay.

In answering Address Dept. I-12

WM. VANDERPOOL CO., Springfield, O.



20th Century Book of Recipes, Formulas and Processes

THIS book of 800 pages is the most complete Book of Recipes ever published, giving thousands of recipes for the manufacture of valuable articles for every-day use. Hints, Helps, Practical Ideas and Secret Processes are revealed within its pages. It covers every branch of the useful arts and tells thousands of ways of making money and is just the book to have at your command.

10,000 Practical Formulas—The Best Way to Make Everything

The pages are filled with matters of intense interest and immeasurable practical value to the Photographer, the Perfumer, the Painter, the Manufacturer of Glues, Pastes, Cements and Mucilages, the Physician, the Druggist, the Electrician, the Brewer, the Engineer, the Foundryman, the Machinist, the Potter, the Tanner, the Confectioner, the Chiropodist, the Manufacturer of Chemical Novelties and Toilet Preparations, the Dyer, the Electroplater, the Enameler, the Engraver, the Provisioner, the Glass Worker, the Goldbeater, the Watchmaker and Jeweler, the Ink Manufacturer, the Optician, the Farmer, the Dairyman, the Paper Maker, the Metal Worker, the Soap Maker, the Veterinary Surgeon and the Technologist in general.

A Mine of Information

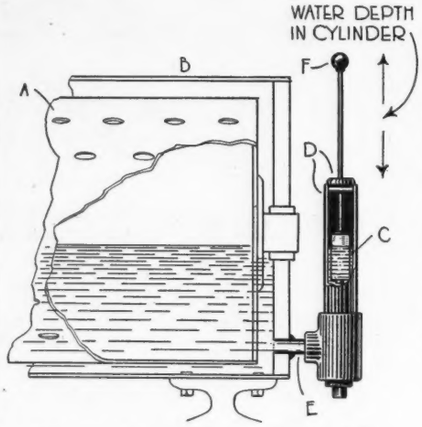
A book to which you may turn with confidence that you will find what you are looking for. A mine of information, up-to-date in every respect. Contains an immense number of formulas that every one ought to have that are not found in any other work. One useful recipe will be worth more than ten times the price of the book.

Price $3.00

POPULAR SCIENCE MONTHLY
225 West 39th St., New York

A Water-Level Indicator for Washing-Machines

OPERATORS of large cylinder washing-machines in laundries know how hard it is to keep clean the water-gage glasses on the gear end of these machines. The glasses are usually placed back of the large gear,



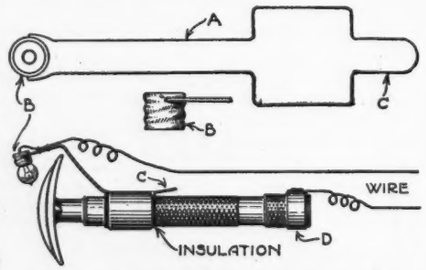
It's easy to read the water-gage if it has a colored ball at the apex of the wire

where it is difficult to see them unless they are in a good light.

A simple indicator, which is much better than the gage-glass, is shown herewith. The cylinder, which revolves in the case *B*, is shown at *A*. The indicator consists of a cork or float *C*, placed in the tube *D*, the latter being connected to the case with a nipple *E*. The indicator *F* is attached to the cork by a length of aluminum wire. A bushing or reducing coupling can be put on top of *D* to act as a guide for the indicator wire, which should slide freely.—JAMES E. NOBLE.

Shave with a Spot-Light on Your Razor

A SPOTLIGHT which can be attached to the common form of safety razor is illustrated below. This can be made from parts of a common flash light battery, or the parts can be purchased from an electrical supply house. Its construction is simple and can be easily detached from the razor



With a light attached to your razor you can't help but get a clean shave

and used for other purposes if desired.

The holder *A* is cut from a piece of spring brass.

This is then bent to resemble the shape indicated; the exact shape depends upon the style of razor the holder of which it is to be attached to.

The broad end is bent in a circular form and clamps about the razor shank. The smaller end is then soldered to the metal lamp-socket *B*. The lug is bent up slightly so that it requires some pressure to touch it to the razor shank. Cement a strip of rubber or cork to the under side of the clip *C*, and solder one end of a light, flexible wire to the other small clip *D*. This slips over the end of the razor handle. A second wire should then be secured to the holder and the end laid over into the bottom of the lamp socket. Do not let the bare wire touch the holder or socket at any point.

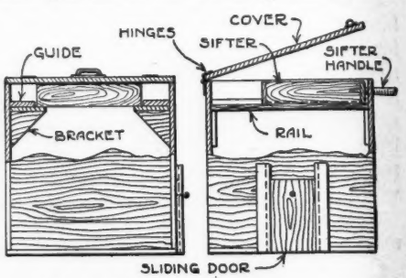
Connect the wires to a dry cell, press upon the lug, and the lamp lights.

The light can be turned on and off at will while shaving. Remove from the razor when it is being washed and cleaned.—L. B. ROBBINS.

How to Make a Dustless Ash-Sifter

HERE'S a way to make your own ash-sifter at one fifth the cost of the store article and to make it so that it will last indefinitely.

Go out to your local grocery store and purchase an ordinary hand ash-



No ash dust can filter all over your clothing if this type of box in used

sifter, which will cost about 15 cents. Get a box from the same grocer a little wider and longer than your hand sifter, which is usually 12 in. wide. Nail four brackets to the ends of the box as shown in the sketch, and nail two strips of wood to the brackets the full length of the box so that the sifter can move back and forth easily.

Cut or burn a round hole through one end of the box so that the handle of the sifter will pass through it. Now cut a hole for the shovel in one end of the box and make a sliding door to cover it. If all joints and covers are tight no dust can escape.

You will be surprised how much money can be saved by a daily sifting of ashes with this contrivance. Not all the coal is burned to fine ashes, by any means. A very considerable proportion of the large cinders is capable of further combustion. The white, shaley lumps should be discarded, but the black cinders consist of what is practically coke, and will make a hot, flameless fire if they are used in the stove.—JAMES WILSON.

Camel Cigarettes

Cigarettes made to meet your taste!

Camels are offered you as a cigarette entirely out of the ordinary—a flavor and smoothness never before attained. To best realize their quality *compare Camels with any cigarette in the world at any price!*

Camels flavor is so refreshing, so enticing, it will win you at once—it is so new and unusual. That's what Camels expert blend of choice Turkish and choice Domestic tobacco gives you! You'll prefer this blend to either kind of tobacco smoked straight!

As you smoke Camels, you'll note absence of any unpleasant cigaretty after-taste or any unpleasant cigaretty odor. And, you'll be delighted to discover that you can smoke Camels liberally *without tiring your taste!*

Take Camels at any angle—they surely supply cigarette contentment beyond anything you ever experienced. *They're a cigarette revelation!* You do not miss coupons, premiums or gifts. *You'll prefer Camels quality!*

Camels are sold everywhere in scientifically sealed packages of 20 cigarettes or ten packages (200 cigarettes) in a glassine-paper-covered carton. We strongly recommend this carton for the home or office supply or when you travel.

18 cents a package

R. J. REYNOLDS TOBACCO CO.
Winston-Salem, N. C.

Amazing Audion Detector Values—$9.50, $11.75 $18.85, $22.00

Remarkably efficient and handsome audion control panels within the price limit of every amateur, built and designed for the audion, as only the makers of the audion can build it. In the past, instruments of this calibre have never been offered at twice these prices.

General Specifications All Models

Beautifully engraved and grained genuine bakelite panels. 4 prong heavy nickled tube receptacles, smooth running, positive acting, adjustable rheostats; impregnated efficient mica stopping condensers; adjustable or fixed grid leaks with polished nickel covers; bakelite covered binding posts with new slotted positive connecting feature; positive segmentally connected nickel plated switches; 40 volt B battery of two 20 volt type units cast en bloc with operating life of 6 to 12 months—a remarkable advance in B batteries; handsome quartered oak cabinets, round corners, standard de Forest "Early English" finish; perfect workmanship and expensive design throughout.

Type P-400 Audion Panel—Consists of tube receptacle, grid leak and condenser, rheostat and binding posts for connection to tuner, A and B batteries on bakelite panel 7½"x7½" without cabinet and B batteries.....**$9.50**

Type P-401 Audion Panel Same as above with cabinet.....**$11.75**

Type P-402 Audion Panel—Larger panel with 40 volt B battery in cabinet...**$18.85**

Type P-500 Audion-Ultraudion Panel—**Type P-402,** Panel with two switches for audion-ultraudion connection and either 20 or 40 volt B battery in cabinet..**$22.00**

Note—All de Forest audion apparatus is sold without the tubes. Audion detector oscillator or amplifier tubes, $7.00 each additional.

Catalog sent on receipt of 10c in stamps to cover postage.

DE FOREST RADIO TEL. & TEL. CO.
1415 Sedgwick Avenue, New York City

"The Construction of Small Alternating Current Motors"

By A. E. Watson, E. E., Professor of Electrical Engineering in Brown University, Providence, R. I.

This book contains complete instructions for building small alternating current motors in several sizes. The designs will be found to be in harmony with those of the very best manufacturers.

Important Information for Electricians

Some of the subjects taken up are "Characteristic features of alternating current motors," "Construction of a one-half horse-power, single-phase induction motor," "Construction of a one-kilowatt, two-phase or three-phase alternating current generator or a one horse-power synchronous motor," "Procedure in testing and using an alternating current generator or synchronous motor," "Construction of a one-half horse-power single-phase compensated series motor."

Clear, concise directions and careful drawings are features of this book. 79 Pages, 47 Illustrations.

Price, $1.00.

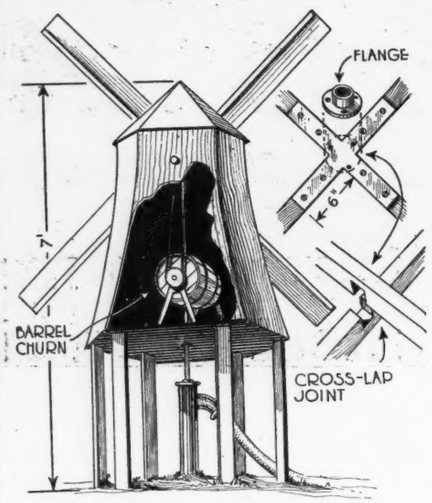
BOOK DEPARTMENT
Popular Science Monthly
229 West 39th St., New York City

A Windmill that Churns the Butter

By Claude Wagner

A YOUTHFUL inventor living in southern California has constructed a windmill that not only will pump an abundance of water for domestic purposes, but will also drive a revolving barrel-churn which supplies the neighbors with butter.

The windmill is of the Dutch type,



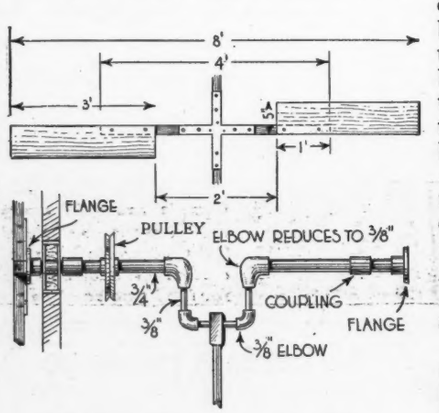
Showing the interior of the windmill and the bearings on which the shaft operate

and is easily made after the style illustrated or in any other form suited to individual needs.

The boards for the four sails of the windmill measure 3 ft. in length by 5 in. in width by ½ in. in thickness, and are attached to a strip of wood 4 ft. long by 2 in. wide by 1½ in. thick, which runs from one sail to the other to attach them in pairs. Each end of the strip runs 1 ft. on each sail, leaving 2 ft. between the blades. The end attached to the sail is cut with a slight bevel, each board being on opposite edges of the stick that binds them in pairs. The sticks to which these sets of sails are attached are set together, allowing the surface on both sides to come flush. A strip of iron is screwed to the sticks on the side that goes nearest the building.

A ¾-in. pipe-flange is attached to the stick that projects from the center of each sail-stick, having a ¾-in. by 3 in. pipe nipple inserted, containing a coupling attached to a pipe. This pipe acts as a driving-shaft for the churn and pump. On the opposite end of this pipe (which comes near the center of the building) an L is screwed in with continued fittings of like size until the pipe forms the letter U, in which the pump-shaft works. The ¾ in. pipe shafting extends to the opposite wall of the building, where another coupling, nipple, and flange are attached, as on the other side. The space between flange coupling on each end of the shaft is taken up by the walls of the building that it passes through. A hollow wooden ring fills this space, and should be filled with hard grease for lubricating the shaft.

Miniature in size, it can be made to resemble its big Dutch brother as well as improve the landscape



If these diagrams are carefully followed when making the shafting, no trouble will be experienced

Drying Out a Generator or Motor

IF a generator or motor has been exposed to dampness before being started in regular service, it should be operated with armature short-circuited beyond the line ammeter, and with the field current so adjusted as to bring the temperature of the windings to about 70° C. The current should then be allowed to flow until the coils become thoroughly dried.

The temperature should not be permitted to drop to such a value as that of the surrounding atmosphere, as the moisture would then again be condensed on the windings, and the machine would be in the same condition as at the start.

It is good practice habitually to dry out, in this way, motors that have been standing for any length of time. Moisture in a motor is not conducive to its good working and should not be tolerated.—PETER J. M. CLUTE.

Drink

Coca-Cola

TRADE MARK REGISTERED

DELICIOUS and REFRESHING

You smack your lips over it, because you like its taste, its quality, its genuine gratification. It satisfies thirst.

Nobody has ever been able to successfully imitate Coca-Cola, because its quality is indelibly registered in the taste of the American public.

Demand the genuine by full name—nicknames encourage substitution.

THE COCA-COLA CO.
ATLANTA, GA.

Sold Everywhere

BIG CUT

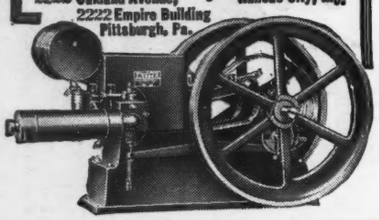
In ENGINE PRICES

Not a cut in quality—but a definite money-saving reduction—All sizes—Gasoline, Kerosene, Portable Engines and Saw-Rigs, 2 to 30 H-P. I can sell for less because I make nothing but engines, buy materials for cash, and sell engines direct to users.

IMMEDIATE SHIPMENT

Let me send you my big new catalog and new reduced price list of kerosene and gasoline engines, FREE, postpaid—then you can judge for yourself. Buy NOW on practically your own terms—get your engine at once and save money. 33 years at it proves WITTE quality. My prices prove the saving. Write me today—Get my offer—ED. H. WITTE, Pres.

WITTE ENGINE WORKS
2222 Oakland Avenue, • Kansas City, Mo.
2222 Empire Building Pittsburgh, Pa.



A Second-hand Lathe and a new
PERFECTION CYLINDER GRINDER
will set you up in a Business that can easily net you $100.00 A DAY

The Perfection re-GRINDER does precision work so much superior to re-*boring* that you will get *all* the automobile, truck, tractor and gas engine business as soon as your enthusiastic customers begin spreading the good news.

Machine itself earns an average of $10 to $15 an *hour*—and profits on oversize pistons and rings are "velvet".

This is your chance to set yourself up in a ready-made business that will earn larger daily profits in proportion to money invested than any other local industry. Send for catalog.

WOOD & SAFFORD MACHINE WORKS
57 Twelfth Ave. North Great Falls, Mont.

Brilliant Electric Lights & Big Profits in BATTERY CHARGING
with this
HB Lighting & Charging Set

With this sturdy, dependable HB outfit, you can make your own electric light at lowest cost, and charge auto batteries at the same time. You SAVE MONEY and make BIG PROFITS. Outfit runs from line shaft or engine. No wear out, trouble proof, economical.

Small Payment Puts this Money Maker in Your Shop

Balance on easy terms. Profits pay for outfit. Absolute Money-Back Guarantee. Ask our Service Department about proper size for your needs. Pin this ad to your letterhead and write TODAY for information.

Hobart Brothers Co.
Box 583 Troy, Ohio
Successful Manufacturers Since 1892

BOOKS

"Practical Armature and Magnet Winding"

This book treats in a practical and concise manner this very important subject. All practical armature windings are fully explained with special attention paid to details. All questions which are apt to arise in the mind of the electrician have been completely answered. This book will prove a most valuable aid to the electrician, either in constructing or operating departments. Full Persian Morocco Leather, Pocket Size, Price, $1.50.

Popular Science Monthly
225 West 39th St., New York

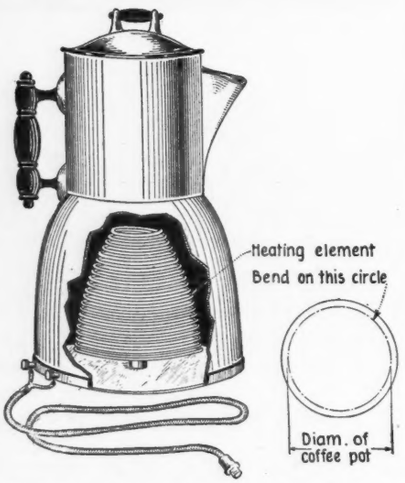
An Inexpensive Electric Coffee-Pot

BY making use of the heating element of an old electric flat-iron, and an ordinary coffee-pot, a very convenient and serviceable electric coffee-pot can be made at practically no cost.

The diameter of the base of the coffee-pot to be used should first be measured and a piece of sheet metal (a tin pie plate will do very well) should be cut into a disk, 1 in. larger that the base of the pot.

Remove the bolts that hold the body and base of the electric iron together. As the heating element is taken from the iron great care must be taken to avoid mutilating the insulation or the fine, high resistance wire.

The edge of the pie-plate disk must be bent up at right angles to its face, or ½ in. all around, to form a shallow receptacle with a diameter equal to



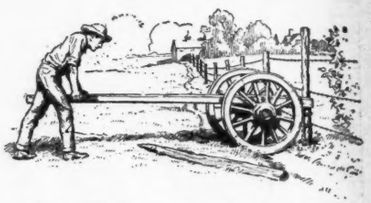
Turn the electrical iron into an electrical coffee-pot by transferring the heating element

that of the coffee-pot. In this receptacle, the heating element is placed, with sufficient asbestos packing to keep it well covered and insulated from all surrounding metal surfaces. Two small holes are then punched in the disk-like contrivance and the binding-posts of the electric iron are inserted in them. The binding-posts must be carefully insulated from each other, and should be spaced so as to allow the use of the plug attachment.

To complete the job, each of the terminals is connected to its binding-post, and the heater is soldered to the coffee-pot.—A. J. MATTHES.

A Post Extractor that Really Does the Work

ALTHOUGH post or stake extractors of the type to be described have been in use many years in construction work and by tent gangs, many people do not even now appreciate the effectiveness and simplicity of this implement. It may easily be adapted to the needs of the farmer or anyone who finds it necessary to repair or remove fence-posts. One of these post pullers may be very easily assembled in a short time, by using a couple of wheels, an axle of some sort, and a wooden pole, 6 or 8 feet long, preferably of oak, for a lever. For wheels, a couple of disks



You will be surprised at the ease with which the post is lifted out when pressure is applied to the lever

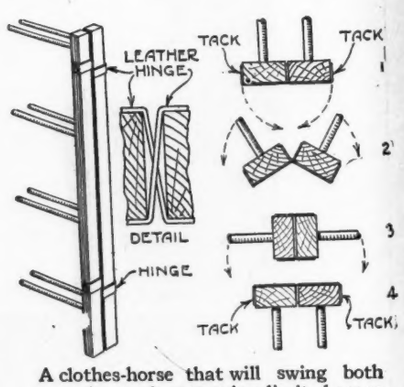
sawed from 1½-in. wood, or a pair of old truck wheels, will serve.

The pole is mounted as a lever with the axle as a fulcrum. In operation, the extractor is pushed up to the stake or post to be drawn from the ground and the chain (one end of which is attached permanently to the lever) is thrown in one or two half hitches around the end of the post or stake. Pressure applied to the long end of the lever will remove a stake at one pull. Where a post is to be removed, the lever end is first pushed down as far as it will go, and then it is lifted and a new grip taken with the chain around the post. Usually two lifts will pull out the post. If the post is stubborn more weight at the end of the lever will accelerate the work.—C. C. WHITMAN.

Fitting a Clothes-Horse with Double-Acting Hinges

A FOUR-SECTION clothes-horse may be quickly fitted with double-acting hinges that will permit its being folded into the smallest possible space.

Being very simple, a description is hardly necessary. Fig. 1 shows a



A clothes-horse that will swing both ways is an advantage in a limited space

section of the article. Figs. 2, 3 and 4 show how the hinges are attached. Selected leather and tacks hammered flush will make the hinges inconspicuous and not detract in any way from the appearance of the clothes-horse.—JAMES M. KANE.

It Catches Fish While You Take a Nap

THANKS to modern methods, we are not compelled to sit on the bank of a stream hour by hour, watching the fish play with our hook. A remedy is now at hand, a mechanical fisherman who is wiser by far than are we—one who knows when to pull,

Sleep as long as you like. When you awake there is a fish safely hooked all ready to be hauled in

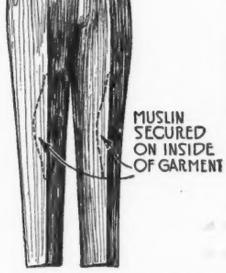
does so with surprising vigor, and produces excellent results.

When the hook is pulled sufficiently, the line, which passes through the various loops, springs the catch, and the pole, becoming free, is pulled quickly upward by a cord of interwoven rubber. Since the line is fastened to the catch, the fish is pulled out of the water with the hook secured firmly in his mouth.

Instead of a sinker, a small glass bottle filled with phosphorus may be used. If the fishing is to be done on a large body of water, the float may be left unanchored and free to float about.—GORDON LOCHER.

To Prevent Trousers from Bagging at the Knee

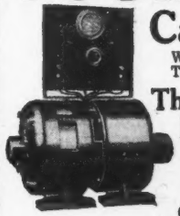
TROUSERS will not stretch or bag at the knee if a piece of strong muslin, shaped as indicated, is secured to the inside of the garment when it is new. This is done with mending tissue and a warm iron, after which the trousers are creased as usual. The muslin should be dampened and shrunk, but should be perfectly dry before applying.



Trousers are prevented from bagging by this simple precaution

If the trousers are already baggy at the knee, this may be remedied by the same method, except that it will be unnecessary to shrink the muslin first. When the trousers are dampened for pressing, the muslin will shrink, automatically taking out the bagginess.—JENNIE E. MCCOY.

YOUR OPPORTUNITY



Canceled Government Contracts

We have secured a large quantity of Small Motors, Generators and Charging Outfits. This material is new, still in original cases and carries the full factory guarantee.

This is Your Opportunity to buy new, guaranteed Electrical Apparatus of Standard Manufacture

1/2 H. P. INDUCTION MOTOR 110 or 220 volts, A. C. 60 cycle, single phase, 1750 R. P. M. $32.50

ALL MOTORS COMPLETE AS CUT

Battery Charging Outfits

For use on 110 volt, A. C., 60 cycle, single phase current only.

80 watts, 8 volts, 10 amperes . $48.50
150 watts, 30 volts, 5 amperes . $68.50
150 watts, 15 volts, 10 amperes . $68.50
300 watts, 30 volts, 10 amperes . $94.50

All outfits complete with switchboard as cut shown.

Mail $5.00 cash or Money Order. We will send C. O. D. subject to full examination.

MONEY BACK GUARANTEE

1/4 H. P. 110 volts A. C., 60 cycle, single phase 1750 R. P. M.

WASHING MACHINE MOTOR

Suitable for operating Small Compressors, Coffee Grinders, Bottle Washers, Lathes Drill Presses, etc. $18.50

WRITE FOR CATALOGUE. BARGAINS IN MOTORS AND GENERATORS. SPECIAL QUANTITY PRICES

220 volts POLYPHASE MOTORS 1750 R.P.M. 60 cycle, 2 or 3 phase. Complete, pulley and base
1 H. P. $59.50 — 3 H. P. $ 84.50
2 H. P. $72.50 — 5 H. P. $102.50

NEW MOTORS

110-220 volts REPULSION MOTORS 1800 R.P.M. 60 cycle, single phase. Complete with pulley.
1/2 Hp. $44.50 — 1 Hp. $67.50

MANUFACTURERS' DISTRIBUTER

CHAS. H. JOHNSTON - West End - PITTSBURGH, PA.

Every User of Tools Will Appreciate This Handy Bag

Made of Harness Leather—Strong and Durable

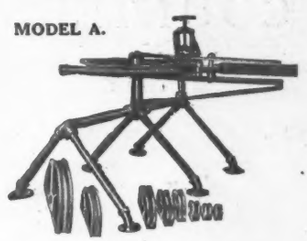
Combines all the good features of the various common leather bags. Strongly built for rough usage. Bottom is three ply and steel studded. Has saw and bit holder, hand strap, and shoulder strap with pad. A mighty good, all-around tool bag. Six sizes ranging from 14 x 8 inches to 24 x 8 inches. Show this ad to your dealer and ask for the genuine KLEIN tool bag. If unable to get it write us.

MATHIAS KLEIN & SONS, Mfrs.
CANAL STA. 3, CHICAGO

POWER BENDERS

THREE NEW MODELS

MODEL A.



"Wonder" Pipe Bending Machines (pat.) electrically operated to bend from 1" to 20". Send for printed matter. We also manufacture TEN other sizes, hand operated to bend from 1/8" to 8".

American Pipe Bending Machine Co.
51 Pearl St., BOSTON, MASS., U. S. A.

OTTAWA KEROSENE ENGINES

Latest design. Durable, Powerful, Reliable, Massive. Built to do hard, heavy work—to give lasting service. Uses Cheapest Fuel. Pulls 25 to 50% more H-P. than rated. Shipped on three months' trial. Easy terms. Sizes 1½ to 22 H-P. 10-Year Guarantee. Book free—postal gets it.

OTTAWA MFG. CO.
1951 King St., Ottawa, Kans.

FREE BOOK

Quality First

TOOL CASES

OF

Machinists and Toolmakers

Write for our booklet showing the best built and most practical selection of Tool Cases on the market. We ship direct from factory and guarantee to please you or refund all money.

A. Gerstner & Sons.
50 Columbia St., Dayton, Ohio

SOMETIMES WE SEE A PERSON WHO DOESN'T USE A

WHITING-ADAMS

TRADE VULCAN MARK RUBBER CEMENTE

SHAVING BRUSH

Very full of smooth best quality bristles or badger hair. They make shaving a pleasure. Treated with U. S. Government's process of preventing infection. Anthrax cannot come from them.

Send for Illustrated Literature

JOHN L. WHITING-J. J. ADAMS CO., Boston, U. S. A.
Brush Manufacturers for Over 109 Years and the Largest in the World

Get its Measure As an Earner

Labor cost is so high for operating *any machine*, that the owner's first problem is to get its measure as an *earner*.

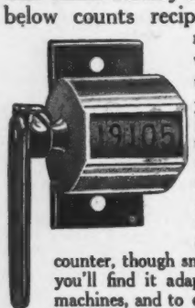
A Veeder Counter will show that the earning capacity of a machine is generally greater than you think for, because seldom is a machine without a counter run at its highest rate-of-work.

By counting production, by showing up labor lapses or mechanical troubles which *limit* production,

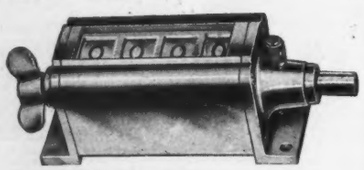
Veeder
COUNTERS

help pay high labor costs by increased earnings from machines.

The small Rotary Ratchet Counter below counts reciprocating movements of the lever, where these indicate the operations of your machine. When lever is moved through an angle of 40 to 60 degrees, the counter registers one. A complete revolution of the lever registers ten. This counter, though small, is very durable; you'll find it adapted to many small machines, and to experimental work in *developing* machines. Price, $1.75.



The Revolution Set-Back Counter below is for larger machines, and registers one for a shaft revolution, indicating an operation.



Set back to zero by turning knob once round; supplied with from four to ten figure-wheels, as required. Price, with four figures, as illustrated, $8.50 (List).

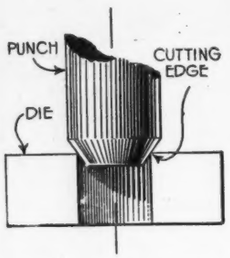
For suitable counters for any counting purpose, look through the Veeder booklet; you'll find what you want there. Write—

The Veeder Mfg. Co.
44 Sargeant St., Hartford, Conn.

A Simple Cloth-Punch for Various Shapes

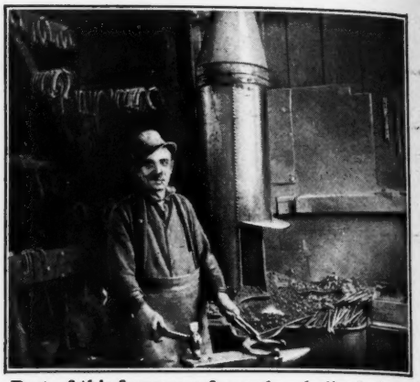
IN button-making, and similar work, it is very often necessary to punch out different shapes and sizes of cloth for covering the metal button form. The goods may vary in texture from Georgette crepe to heavy suiting material.

If you have ever tried punching cloth with an ordinary punch you have probably noticed how the threads pull down in the die, distorting the blank and often pulling out several entire threads on the ends where the threads were shortest. The punch and die shown in the illustration will eliminate this trouble as the threads cannot be pulled down into the die. They are squeezed off without any pulling.—S. B. ROYAL.



Cutting the fabric clean without leaving threads is the claim of this punch

An Old Boiler Makes a Forge Cupola



Part of this forge was formerly a boiler before the blacksmith put it to its present use

A VERY good cupola for a blacksmith's forge can be made from a discarded hot-water boiler by cutting out both ends and a flap from the side at one end as shown in the illustration. The flap cut out is bent up so as to form a hood over the fire and direct the smoke and waste gases up the cupola. Small angle-irons are riveted on at the bend for the purpose of holding it in place.—HARRY MEAD.

A Good Way to Transplant Garden Truck

COVERING garden truck, such as cabbage, celery, etc., for two or three days will usually insure its taking root and promote sturdy growth.

If hundreds of plants are to be set out it is too much of a task to screen them all, but where a small number—even a hundred or two—are transplanted, it is decidedly worth while to protect them from the start.

The protector should be one that can be quickly and cheaply made and, in addition, is convenient to handle. The one herewith described has all these advantages, and besides can easily be stowed away.

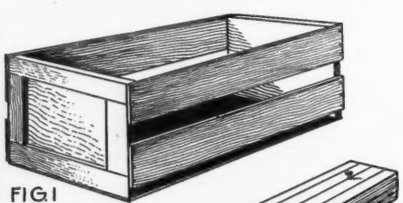


FIG. 1

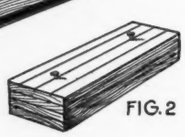


FIG. 2

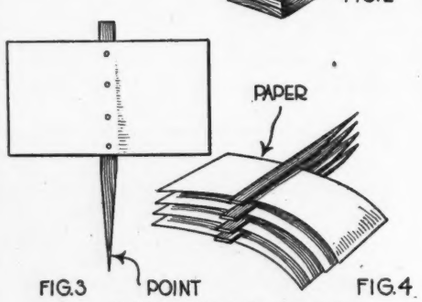


FIG. 3 FIG. 4

Save all those old crates to make into shades for your young plants

An empty orange or lemon crate, sawed in half, will furnish the stakes, the ends of the crate being discarded.

Tack a number (four or more) of the sawed sections together, as shown in Fig. 2, and saw them into narrow strips $\frac{5}{8}$ in. wide. Since they are tacked together, a number of the strips may be sawed at one cut. This type of crate should yield about 100 strips $13\frac{1}{2}$ in. long by $\frac{5}{8}$ in. wide. Each stick should be pointed as in Fig. 3.

Cut cardboard or heavy wrapping-paper into pieces 16 in. long by 6 in. wide, and tack the paper to the strip about 1 in. from the top of the stick. This leaves a handhold by which the stick may be pushed into the earth.

Fold the paper into cone form, securing it with wire clips or pins.

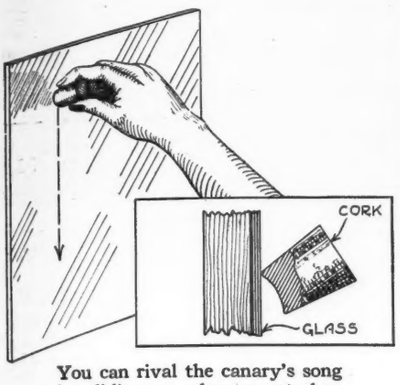
Here is a different form of shade, made of wrapping-paper, which needs only to be pinned

FIG. 5

This will make a different form of shade, and one that may be used to cover the plant entirely if necessary or desirable.—JAMES KANE.

Imitating the Birds with a Hollow Cork

IN amateur or home theatricals it is often necessary to imitate birds. The picture will show you how to accomplish this with a fair sized cork, hollowed out at the bottom and



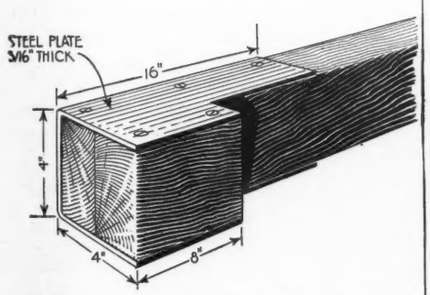
You can rival the canary's song by sliding a cork over wet glass

pressed against a piece of wet glass.

By means of corks of different sizes, and hollowed out to different depths, two or more persons can render an exceedingly realistic bird accompaniment to a piece of music. Anybody at all familiar with musical time can obtain very pleasing effects by this makeshift method.—FRANK BENTLEY.

A Starting Bar for Stationary Steam Engines

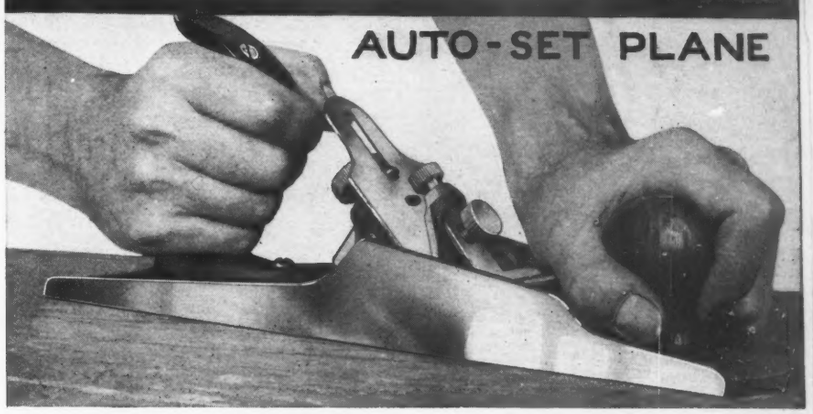
LARGE stationary engines often stop at dead center. To turn the shaft and fly-wheel so that the piston can move them, and for inspection purposes in cleaning, a starting or turning bar is used. Holes are made in the fly-wheel into which the bar is inserted, while one or more men lift



Starting a steam engine requires the strength of a giant, but to lever it over is simple

upon it. With still heavier engines, a stand is erected on the floor close to the wheel and the bar fulcrumed on this for greater leverage, while the men bear down on the free end. One of these starting levers can be made as shown in the drawing for medium-sized engines. A plate of steel is bent and screwed to the wood to resist the wear, and a wider end is secured by bolting on an additional piece of the same kind of wood.—DONALD A. HAMPSON.

SARGENT



True, fast-cutting and easy to keep sharp

A SARGENT Auto-Set Bench Plane can be taken down for whetting and instantly re-assembled with exactly the same set of the cutter. That's the new auto-set feature.

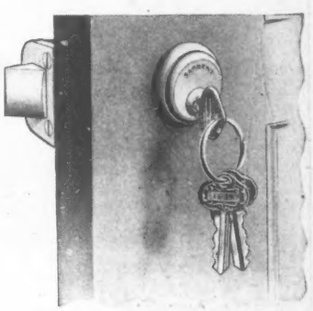
It's the kind of a tool a good mechanic is glad to own. Whether doing heavy or very fine work—even when planing against the grain in tough hardwood this plane cuts true and without chatter. Once regulated for the job in hand it holds the set until you alter it. Made in six sizes and several styles.

Fully described in our catalog, sent free on request.

SARGENT

Cylinder Day and Night Latch

Keeps intruders outside



Put on a Sargent Cylinder Day and Night Latch and be safe. Fits either right or left hand doors.

It is self-locking. Closing the door springs the latch—you can't forget to lock up.

Any hardware dealer will show you one.

SARGENT & COMPANY, *Hardware Manufacturers*

50 Water Street, New Haven, Conn.

LOCKS AND HARDWARE

Pilliod

TOOL CASES EXCEL

Machinists and Tool Makers find them most satisfactory in construction, appearance, service and price. Immediate shipment.

Booklet describing 20 styles on request.

The Pilliod Lumber Co.
Dept. A, Swanton, Ohio

WIRE electrical, rope, airplane, piano, pipe-organ, flat, hoops, bale-ties, tacks, nails, barbed-wire, concrete reinforcement, springs, netting, wire fences, steel posts, trolley-road wires and rail bonds, wire wheels, auto-towing cables, horse-shoes.

Illustrated Books Describing Uses, FREE

American Steel & Wire Co. F. Baackes, V.P. & G.S.A. CHICAGO

ASBESTOS

We are miners and shippers of Crude Asbestos in any quantity. We produce all grades at our world famous BELL ASBESTOS MINES, in Canada. We also card fibres, spin yarns, weave cloths, and make all sorts of Asbestos products.

For anything you want in Asbestos, turn to

KEASBEY & MATTISON COMPANY
Dept. S-4, AMBLER, PENNA., U. S. A.
Owners of the world's largest Asbestos Mines.

THE MIDGET SLIDE RULE

will solve any problem in addition, subtraction, multiplication, division and proportion. A Log-Log scale gives any root or power of any number. Gives Logarithms, Sines, Tangents, Cosines, Cotangents and the decimal equivalents of fractions to six decimals. It is grease and water proof and will give years of service. This rule is not to be compared with the paper utility rules which sell for $1.00 and are put together with paper fasteners. It is accurate, simple to operate and comparison shows that it is undoubtedly the fastest and most complete rule made. Our refund guarantee protects you from loss or disappointment. An instruction book, 16 pages, 12 illustrations, is sent with each rule. Diameter 4 inches. Made in two models. Metal (white coated steel) $1.00. White Celluloid, $1.25. Leather Case, 50c. extra. Your money back if you are not satisfied. Send for Catalogue of Slide Rules.

GILSON SLIDE RULE CO., NILES, MICH.

Permanently Accurate Service

Just as Brown & Sharpe Tools come from the factory accurate, reliable and serviceable so will they remain.

This is not an ordinary statement. Eighty years of tool making is a guarantee that speaks for itself.

Let us send you Catalog 27, select what you need and time will make you one of our many satisfied machinists.

Brown & Sharpe Mfg. Co.

PROVIDENCE, R. I., U.S.A.

Solar Observations without Instruments

SOLAR observations for time can be made without a transit instrument to within a few seconds of correct time, by arranging for a pinhole image of the sun to fall on a plane about 10 ft. away, the plane having the meridian indicated on it by a fine black line across its surface.

The plane is set at such an angle as to receive the image of the sun at its center point on September 22, or March 21, this giving a distance each way north and south to take care of the changes in the yearly declination.

Flash! The sun cuts the meridian, and by a series of figures you adjust your watch to the correct time

By arranging the plane at the angle of the observer's latitude the sun's disk will fall nearly perpendicularly each side of the center point, not changing enough to affect the time of transit or the observations.

The plane should be about 10 ft. long if set 10 ft. below the pinhole and in such a position that the meridian extended below the pinhole will pass directly beneath it. This can be done with a plumb-bob and the meridian extended from the plane with a string, so as to cut the point.

A thin piece of metal, set in the roof or window, with a pinhole in the center, will give a disk 1 in. in diameter and fairly sharp. By close observation the movement can be seen for one second of time as the disk cuts the meridian.

Using the Nautical Almanac, the time of transit for any day can be calculated and thus the time for that day be taken by the observer.

Having your longitude from the nearest standard meridian East, in degrees and minutes of arc, reduced to its equivalent of time will give the correction to be applied so as to get the time the mean sun will cross your meridian.

Then, by using this with the Equation of Time as taken from the Almanac, adding if positive and subtracting if negative, and subtracting from this result the time of semi-diameter of sun gives the time the West limb of the sun will cut your meridian.

Note the time the sun makes contact and the difference in the time of your watch and the calculated time is your clock arrow.

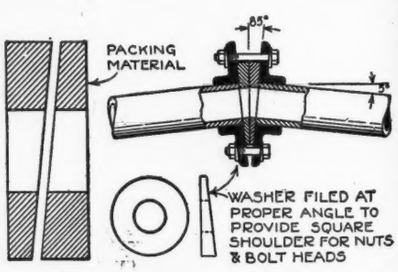
As an example from my point of observation for August 25, 1918, we have the following, figured from the 75th meridian:

Mean noon at the 75th Meridian	12.h	00.m	00.s
Correction of longitude		27.m	36.s
Mean sun on my Meridian	12.h	27.m	36.s
Plus 1 hour for summer time	1.		
	1.h	27.m	36.s
Mean noon my Meridian		2.m	7.s
Equation of time August 25, 1918. plus	1.	29.	43.
Sun on Meridian		1.	5.
Semi-diameter to pass. Subtract	1.	28.	38.
West limb cuts Meridian	1.	27.	36.
Watch read		1.m	2.s Slow

The above could be used in places in the country where there was no telephone connection and the clocks be set to within a few seconds of correct time.—E. D. BALL.

How to Make an Eccentric Pipe-Flange

WHEN a pipe line must make a bend of 5 or 10 degrees, it is generally necessary to bend the pipe, if flanged fittings are used, and this is quite a job, especially in the larger sizes of pipe. It is easily done by making a gasket, such as is shown in the illustration. Cut out a ring of thick leather, or other suitable material, the hole inside being equal to the inside diameter of the pipe and the outside diameter, just so the flange bolts will clear it. Then saw it in two diagonally, the angle being half of the desired angle of change in the pipe line.

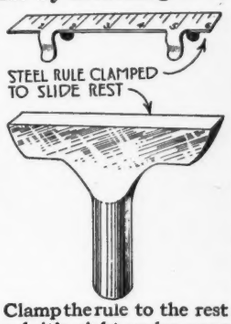


Here's a practical way to make a bend in a pipe at any angle you may wish

Turn one side completely around and clamp it into place. It may be necessary to attach a washer in case the pipe is bent more than a few degrees.—VICTOR H. TODD.

Turning the Lathe-Rest into a Scale

NONE knows better than the machinist the value of the scale, but few know that by attaching it to the lathe-rest time and labor can be greatly shortened.



A thin steel scale is attached to the lathe-rest by means of clips soldered or clamped to the scale. These can be bent in such a position that they will firmly snap to the lathe-rest, holding the scale securely and in the position desired.—THOMAS F. MURPHY.

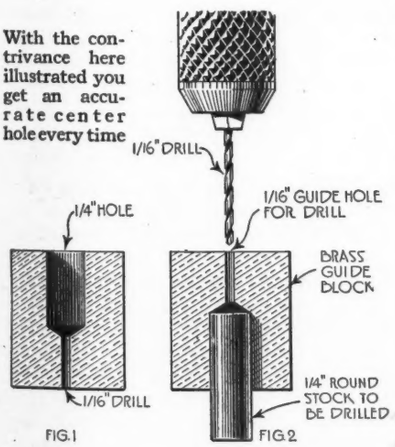
Clamp the rule to the rest and it's right under your hand when you need it

A Center Guide for Round Piece Drilling

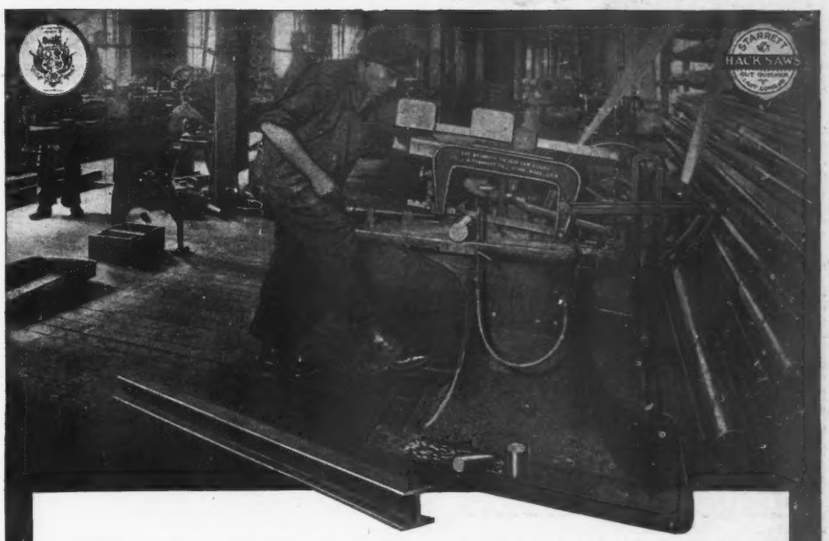
IT is a difficult job for the mechanic to drill a small hole in the center of round stock, which also is of small diameter. By following these instructions and the diagram carefully the job can be neatly and efficiently done.

For instance, if the mechanic wants to drill a 1/16-in. hole in a piece of round stock ¼ in. in diameter he proceeds in the following manner. First a fixture is made as in Fig. 1 from a block of brass or iron about ⅝-in. square. A ¼-in. hole is drilled in the block three quarters of the way through. Then a 1/16-in. hole is drilled by passing the 1/16-in. drill through the ¼-in. hole which will center itself in the incline left by the ¼-in. drill.

With the contrivance here illustrated you get an accurate center hole every time



This completes the fixture. Now the ¼-in. stock is passed through the fixture, which is then put in the bench drill. It is understood that this fixture is only to be used for ¼-in. stock and additional sizes must be made up with other fixtures to suit the size work.—T. P. GATHMANN.

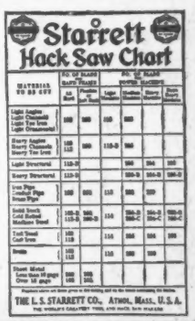


CHOOSE YOUR BLADE TO FIT YOUR WORK

IF YOU'VE been cutting 3" round machine steel with a heavy gage, coarse blade and find your next job is on structural beams—7" I-beams, for instance—it's cheaper to change to a blade designed for that class of work than to keep on with the coarse blade you used on round stock.

The smaller the cross-sectional area to be cut, means fewer teeth engaged at any single instant and a corresponding increase in wear on the blade at that point. Also, the fewer teeth used the sooner they will dull and the greater likelihood of stripping.

That's *one* reason why the Starrett Hack Saw Chart recommends different blades for different kinds and shapes of metal. In this case, our tests show that a blade with more teeth to the inch should be used on structural steel than on round stock.


Starrett Hack Saw Chart

Write for Starrett Hack Saw Chart W.

THE L. S. STARRETT COMPANY, Athol, Mass.

The World's Greatest Toolmakers

Manufacturers of Hack Saws Unexcelled 42-933

Starrett Hack Saws

GENUINE

Armstrong Stocks and Dies

HINGED PIPE VISES
PIPE CUTTERS
PIPE AND BOLT DIES

MANUFACTURED BY

THE ARMSTRONG MFG. CO.

337 Knowlton Street - Bridgeport, Conn.

BIG PROFITS for YOU in HB BATTERY CHARGING

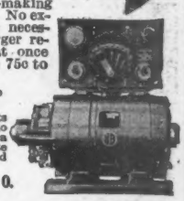
New Lower Prices Now in Effect

Make $100 to $200 Clear Profit Each Month

Lower cost—smaller cash payment—Bigger Profits. Start now to build big money-making business charging auto batteries. No experience or electrical knowledge necessary. This HB 500 watt Charger recharges 1 to 7 6-volt batteries at once for 10c to 15c each. Owner pays 75c to $1.50. Figure those profits.

Small Payment at New Lower Price Puts this Charger in Your Shop

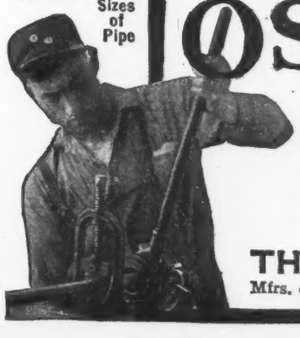
Balance on easy monthly terms. Profits will easily pay for outfit. No burnouts, no expensive renewals—steady 24 hours a day service with BIG PROFITS. Absolute Money-Back Guarantee. Tear out this ad and mail TODAY for information.



Hobart Brothers Company, Box 581, Troy, O.

Successful Manufacturers Since 1892

Each "Bull-dog" Threads 4 to 8 Sizes of Pipe



OSTER BULL-DOG DIE-STOCK

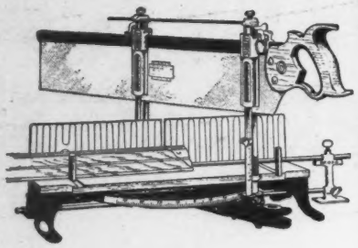
A LIGHT-WEIGHT stock, easy to operate. Ask your Supply House about No. 102, which threads 6 sizes—¼, ⅜, ½, ¾, 1 and 1¼ in.

Folder on request

THE OSTER MFG. CO. CLEVELAND, O., U. S. A.

Mfrs. of Bull-Dog Die-Stocks and Oster Power Threading Machines

Stanley Tools



Stanley Mitre Boxes

Strong—Durable—Accurate

A Few Striking Features

Saw is held above work when not in use.

Swivel is automatically locked at any angle.

Two sockets in swivel for use of long or short saw.

Narrow opening in back of frame, especially adapted for small work.

Steel rod uprights for saw guides.

Uprights adjustable for saws of varying thicknesses and for those that run out of true.

Stock guides for holding work in place.

Extra wide range for work—will saw at angle of 30 degrees.

One-Piece frame with detachable malleable iron legs.

Construction thoroughly mechanical; all parts interchangeable and readily replaced if lost.

Quickly and easily put together or taken apart for carrying.

A specially made back saw furnished with each box

STANLEY RULE & LEVEL CO.
NEW BRITAIN, CONN. U.S.A.

How to Shore Up the Sides of an Excavation

THE method here shown of shoring up an excavation is one used by a grave-digger. To guard against the top soil falling or slipping in, the digger notched out a section of the ground and fitted in two wide planks. He then finished the excavation. After filling, the planks were easily removed before tamping.—JAMES M. KANE.

Shoring up the sides of an excavation eliminates the laborer's chances of an accidental burial by holding back the surface soil

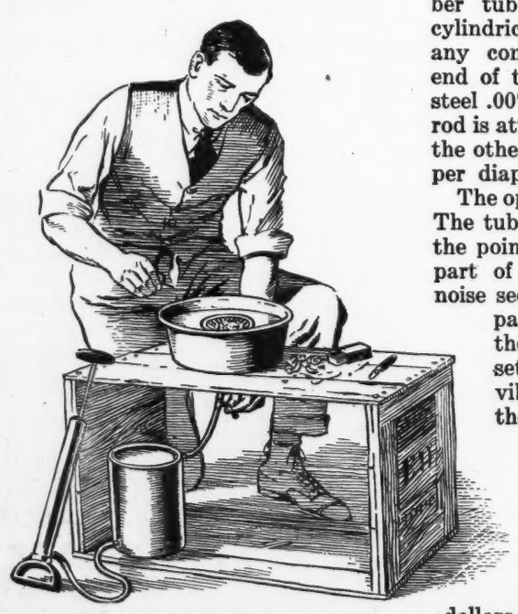
A Miniature Forge for the Amateur Mechanic

A SMALL forge, which is eminently suited to the needs of the amateur mechanic, can be constructed from simple and readily accessible materials. It is made to burn charcoal, and a very considerable temperature can be obtained.

The firebox is made from an old graniteware dish with a burner taken from an oil-stove firmly fastened to the bottom. The firebox is fashioned of soft cement and allowed to harden. If clay is obtainable this should be used as it is superior to the cement. A small square of wire screen should be placed over the opening to prevent ashes from getting into the tubing.

A pressure-tank is made from an old tin can of about one gallon capacity, soldered air-tight and the necessary openings and connections made. Between the pressure tank and firebox, a valve is installed which regulates the air supply. This may also be secured from the oil-stove. Another valve should be inserted at the inlet of the tank, and also one at the outlet of the pump.

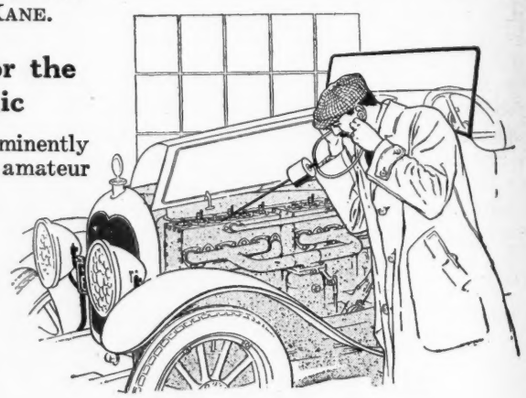
To operate, pump a supply of air into the tank, start a fire in the firebox and admit air slowly through the upper valve, then feed the fire with charcoal.—DALE VAN HORN.



If the air in the tank is used carefully one tankful will last a long time

Make a Stethoscope to Find Engine Knocks

A POWERFUL stethoscope for locating knocks in machinery can be made at small expense. It consists of a cylindrical chamber about 4 in. in diameter and 4 in. long, to one end of which is attached a long rod to touch the machine being tested. From the other end are run two rubber tubes, one to each ear. The cylindrical chamber may be made of any convenient material. The rod end of the chamber is made of shim steel .007 in. thick, and the end of the rod is attached to it with rivets. Near the other end of the chamber is a copper diaphragm—16-gage material.



"Listening in" on the heart-throbs of an automobile engine

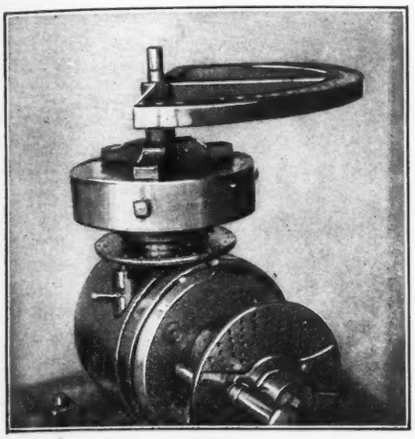
The operation of the device is simple. The tubes are placed in the ears, and the point of the rod is rested on that part of the engine from which the noise seems to come. The vibrations pass from the motor through the rod to the steel diaphragm, setting it in motion, and the vibrations are transferred to the ear.

With this device in your tool-kit you can always be on the lookout for engine trouble. The stethoscope will warn you that trouble is approaching, and, if you heed, it will save you many dollars that would otherwise be spent in repairs.—ERNEST SCHWARTZ.

A Drill-Press with a Milling-Machine Dividing-Head

A PIECE of work had to have a number of holes drilled in it on a circle, so that the distance from the center of one hole to the center of the next would be .622-in. The work would not swing in the milling-machine, so the dividing-head from the milling-machine was set up on the table of the drill-press.

The work was placed on a mandril and held in the chuck on the dividing-head. There were thirty-five holes in the half circle, making seventy holes in a full circle. By using the index



Here is a clever scheme by which a mechanic can combine two machines

plate with a circle of twenty-one holes and moving over twelve holes for each division, the distance between each hole was measured.

As a further assurance of accuracy, all holes were first drilled with a No. 40 drill, which produced a pilot hole for the ⅜-in. drill.—HARVEY MEAD.

Direction for Reducing a Coupling Bore

WHEN it is necessary to use a shaft coupling the bore of which is too large, the following method can be employed to reduce the bore to the required size.

The coupling bore is made true again by taking another cut, and since the cut cannot be made deep enough to remove the old keyway altogether, a bushing is turned to fit the coupling and the shaft. A new keyway is then cut in the bushing to correspond with the old keyway, and an additional keyway is cut to fasten the coupling to the shaft.

After placing the coupling on the shaft the key holding the bushing to the coupling is driven in first to tighten the bushing, and then the key to hold the coupling to the shaft is hammered in. This method will give as much satisfaction as a solid coupling with a bore of the required diameter, and in shops out of the beaten track of railroads will do much to save time and expense.—PETER J. M. CLUTE.

SIMONDS
SAW STEEL PRODUCTS

Use these Saws for Business Economy

SIMONDS Steel, tempered as it is in our factories, gives our saws edge-holding properties that increase their value to the user. The longer a saw holds its cutting edge the better the saw.

Simonds saws, machine knives, cutters, files, etc., are enduring. They outlast strenuous usage. They cut profitably.

Write for Prices

Simonds Manufacturing Co.
"The Saw Makers" Established 1832
Fitchburg, Massachusetts

Chicago, Ill. Portland, Ore.
Lockport, N. Y. Seattle, Wash.
New York City Vancouver, B. C.
Memphis, Tenn. St. John, N. B.
New Orleans, La.
London, England
Montreal, Que.
San Francisco, Cal.

Take the danger out of darkness with the new LIBERTY DAYLO, No. 3661. It leaves both hands FREE

DAYLO Is Your Ever Ready Friend

WHERE is YOUR "flashlight?" Battery dead? Bulb gone?

That's easy to fix. Just open the case and, printed there on the side of the Eveready Tungsten Battery is a number which instantly tells the Daylo dealer on the next corner what size you need—you don't have to take the light.

Stop in at lunch time. He has an Eveready Tungsten Battery to fit every Daylo or "flashlight." Eveready Mazda Bulbs, too.

Do it to-day—then you won't have to *wish* for your Daylo when you need it tonight—you'll *have* it.

AMERICAN EVER READY WORKS

of National Carbon Company, Inc.

Have a regular place to keep your DAYLO—in the pocket of your car, on the kitchen shelf, in the top of your suitcase when you travel.

Long Island City, New York
Canadian National Carbon Co., Limited, Toronto, Ontario

Accept no substitute for the genuine Eveready Tungsten Battery. The longest-lived, brightest-burning battery for "flashlights."

With that long-lived EVEREADY *Liberty* DAYLO *Tungsten Battery*

626